SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XLI JULY, 1925 NUMBER 1

COMPRESSION OF THE SPINAL CORD AND ITS ROOTS BY HYPERTROPHIC OSTEO-ARTHRITIS

DIAGNOSIS AND TREATMENT[1]

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SINCE the publication by Bailey and Casamajor, in 1911, of their report on a series of five patients suffering from damage to the cord and its roots from chronic inflammatory disease of the spine, there has been very little added to the literature on the subject. From this may be deduced the relative rarity of the condition. It is, however, of considerable importance to be able to recognize it and differentiate it from other causes of compression myelitis, especially spinal cord tumors. Elsberg, in his book on diseases of the spinal cord and its membranes, admits the rarity of symptoms of cord compression in osteo-arthritis of the spine, but gives a report of a patient on whom an exploratory laminectomy had been performed, and this condition found. The patient was relieved of his symptoms following the operation. Pastine reported a case of osteo-arthritis in the cervical region, with involvement of the cord. The patient had spastic paraplegia, loss of sexual power, and slight sensory changes in the area supplied by the fifth and sixth cervical roots. Laminectomy was not performed. Sicard advised surgery in a patient who had a severe root pain, but no other neurologic signs. After a stormy convalescence, the patient made a good recovery. At operation the dura was found to be thickened and wrinkled. Two of Bailey and Casamajor's patients were operated on. In one there was marked thickening of the laminæ and spinous processes with softening of the bone, which was grayish. The dura was congested, but otherwise normal. In the other case, there had been a previous injury to the spinal column and an overgrowth of bone was found compressing the cord, almost at a right angle. Over the gibbus the dura was covered with granulation. The bone seemed healthy and was not softened.

The following case reports represent a further contribution to the whole problem, both as regards diagnosis and treatment.

CASE 1. Mr. J. McF. came to the Mayo Clinic January 7, 1924, complaining of inability to walk. He had had transitory pains in the shoulder and knee-joints for 3 or 4 years, worse in damp weather and relieved by rest. Six months before coming to the clinic, he had noticed a constant pain in the mid-dorsal region, as well as in the lower end of the sternum. At the time of onset of this pain, he had furuncles in the right axilla, which ran their course and disappeared in 6 weeks. The pain, however, continued; it usually began when the patient rose in the morning, and became worse as the day went on, reaching its maximum at 5:00 p. m. Relief was obtained by going to bed. Bending his head on the chest caused a sharp pain in the mid-dorsal region; also coughing and sneezing produced a similar exacerbation with pains radiating down the posterior aspect of both lower extremities. Four months before, he had noticed numbness in the dorsum of his feet which in 3 months had ascended gradually to the lower end of the sternum and mid-dorsal region. Weak-

[1] Read before the Western Surgical Association, French Lick Springs, Indiana, December 4-6, 1924.

ness and unsteadiness appeared simultaneously in the lower limbs so that the patient became unable to stand or walk alone, although he had good power in the legs when he was lying in bed. The pain was inconsiderable while he was resting quietly in bed, but on attempting to sit up or walk, sharp paroxysms were produced.

The patient was a well built, healthy looking man. Urinalysis, blood counts, and the blood Wassermann reaction were negative. Spinal fluid examination showed a negative Wassermann with a positive Nonne test; there were seventeen small lymphocytes to the cubic millimeter, and the spinal fluid was yellow. There was no response to pressure on the jugular vein while the spinal fluid was being withdrawn. X-ray of the dorsal spine showed a slight hypertrophic arthritis, but the lumbar spine and sacrum seemed normal. Neurologic examination revealed a marked anæsthesia of the lower extremities and trunk, which terminated at the third dorsal segment. This anæsthesia was applicable to pain, touch, and thermal sensibility; vibration and joint sensations were equally involved. Motor power tested in bed was remarkably good, considering the degree of anæsthesia. The tendon reflexes were exaggerated, abdominal reflexes were lost, and Babinski's sign was noted on plantar stimulation of either foot. The patient's chief disability lay in the marked ataxia, which prevented him from walking or standing alone. There was slight tenderness on pressure of the spine at the third dorsal vertebra.

Surgical exploration. January 16, 1924, the laminæ and spines of the first, second, third, and fourth dorsal vertebræ were removed. The bone was markedly hypertrophic, vascular, and spongy, so that it was possible to break off masses of bone with a periosteum elevator. The spinal canal was markedly narrowed throughout the whole extent of the exploration, but its narrowest part was opposite the third dorsal vertebra. The cord was normal in appearance, but constricted and reduced to about four-fifths of its normal size. The dura was not opened, since we were unable to palpate a tumor of the spinal cord, and we felt that the constriction of the cord by a narrowing of the spinal canal explained the neurologic symptoms. It was difficult to control the oozing from the soft, spongy bone, and we felt that it was better to avoid opening the dura for purely exploratory purposes.

The patient was examined 6 months after the operation. At this time, he could walk without assistance. The anæsthesia had disappeared, leaving a hyperæsthesia and formication. Babinski's sign was still present, as well as an exaggeration of the reflexes, but the patient was remarkably improved and able to resume his former occupation.

The ultimate conclusion in this case could only have been that there was a focal compression lesion involving the cord. The previous transitory joint pains, furunculosis and the pleocytosis in the fluid might put one on guard as to the possibility of inflammation in the cord, meninges, or vertebræ. The type of pain which varied so greatly with posture and movement was different from the spontaneous nocturnal pain in vertebral or spinal cord tumors. The marked loss of sensation, out of proportion to muscular weakness, was peculiar, but might indicate that the maximal pressure on the spinal cord was posterior.

Roentgenologic findings in this case were of no assistance. At the time of operation when the lesion was exposed, the plates were checked carefully for anything suggesting the gross bone disease that was encountered. The only evidence was a slight lipping at the edges of the vertebræ, such as might be seen in many patients without any symptoms of vertebral or cord disease. Furthermore, a hypertrophic arthritis is common in the same area of the spine wherein a spinal cord tumor is situated. Elsberg and others have reported this repeatedly. Altogether the differential diagnosis between the condition revealed at operation, and an extramedullary spinal cord tumor is a problem of great difficulty. The combination of pleocytosis in the fluid and postural pain seemed to be the only helpful factors in this case.

CASE 2. Mr. C. K., aged 51 years, came to the clinic June 20, 1924, complaining of weakness in the left arm and leg, and pain down the left arm. Five years before, he had noticed a dull, aching pain in the left elbow, most marked while doing hard, manual labor. This lasted about a year. Two years before, a numb sensation had appeared in the left index finger, with an increased sensitiveness around the base of the finger and thumb. One year before, he had noticed that his left hand tired more readily than the right, and was slower in action; yet he could still do rapid work on a linotype machine. Nine months before, a slight weakness of the left leg resulted in a noticeable limp. For a year he had noticed that coughing or sneezing produced a pain radiating down the medial surface of the left arm and forearm into the index finger. He had no pain at night, but occasionally there was a leakage of urine when the desire to urinate was urgent; also of fæces, after a cathartic. His sexual power was greatly diminished.

At the time of the examination, the patient was a healthy looking man with a slight limp in the left foot. The spinal fluid test and blood Wassermann reaction were negative; there was a negative Nonne in the fluid, and two small lymphocytes for each

cubic millimeter. The physical properties of the fluid were normal, and there was a prompt response to jugular compression. Roentgenologic examination of the cervical spine revealed hypertrophic arthritis of the fifth, sixth, and seventh cervical vertebræ, moderate in degree.

Neurologic examination revealed a Brown-Séquard lesion, with weakness and loss of speed of the left upper and lower extremities. However, this impairment was slight, and the patient could walk and use the left hand for everything except very rapid and fine movements. The left leg was slightly spastic; all tendon reflexes were increased on that side, and the abdominal reflexes lost. There was Hoffman's sign in the hand, and Babinski's sign in the foot on that side. The right upper and lower extremities were normal for power, speed, and tone, but there was a distinct anæsthesia in the right lower extremity, and right trunk as high as the third dorsal skin segment. The patient was hyperæsthetic over the right index finger and metacarpophalangeal joints.

Surgical exploration. August 27, 1921, the spines and laminæ of the third, fourth, fifth, sixth, and seventh cervical vertebræ were removed. There was an overgrowth of bone in the body of the sixth cervical vertebra, more pronounced on the left side, so that the cord was pressed laterally and posteriorly. The cord opposite the body of the sixth vertebra was markedly congested and flattened. The dura was opened and left open. The patient was examined again, a month after operation. He had more power in the left side, and the sensory disturbance on the right side was less marked.

The hyperæsthesia of the patient's index finger and hand, and the pain radiating down the center of his arm and forearm when he coughed or sneezed were relatively early symptoms, and were given due importance in determining the level for exploration. The development later of a Brown-Séquard syndrome indicated progression, and although at time of examination the anæsthesia had reached only the second dorsal skin segment, the level indicated by the root pain was given great consideration in determining the site of disease.

A cord tumor was selected as the most likely cause of his trouble, partly because there was so little evidence before operation of gross vertebral disease, and partly because the signs of cervical cord tumor early in its course are often even less marked than in this case. Roentgenologic examination revealed haziness in outline of the vertebral joints and margins, and these findings were interpreted as being due to hypertrophic arthritis. On the other hand, there was little clinical evidence to support this assumption, since there was no sign of cervical pain, rigidity, or tenderness. However, it was evident that there was a progressive focal compression lesion of the cervical cord and exploration. The findings at operation were, as often happens in such cases, a complete surprise, and this case remains particularly baffling from the standpoint of the underlying disease.

CASE 3. Mr. G. A. S. came to the clinic July 22, 1924, complaining of pain in the back, radiating into the posterior aspect of the left lower extremity, and of weakness of the left foot. He had had intermittent pain for the last 15 years in the lower lumbar region and sacro-iliac joints. This had never been severe, and never lasted longer than 3 or 4 days. He had, however, been incapacitated twice by this pain, and it was always worse on motion and relieved on rest. Five years before coming to the clinic, he had driven a tractor 30 miles, and was forced to stand with his weight on the left leg for the entire distance. Following this, severe pain developed in the lower lumbar region and the posterior aspect of the left thigh. It lasted 30 days, and he was in bed 3 weeks. Although he was kept awake at night, the pain was much worse on motion, and rest in bed afforded almost complete relief after the first week. He had had no further trouble until 2 months before coming to the clinic when a similar attack came on, lasting 7 days; he was in bed most of this time. Five months before, he had developed similar pains after heavy lifting. While lifting he noticed a sudden, stabbing pain in the lower lumbar region, and within 3 days it had become extremely severe, radiating down the posterior aspect of the left thigh. Four days after onset, a numbness appeared in the left leg and foot, and a weakness in dorsiflexion of the foot. The pain had continued up to the time of his examination, and although it did not disturb his sleep, it incapacitated him for work.

The patient was a well developed, muscular man, who walked with a limp and had to use a cane. He also wore a spinal brace to relieve any strain on his back. There was marked rigidity of his lower lumbar spine, and spasm of the muscles in that area. Roentgenologic studies of the lumbar spine and sacro-iliac joints did not reveal anything of importance. The spinal fluid was a very faint yellow, but there was a prompt response to compression of the jugular veins. All other tests on the spinal fluid were negative. Neurologically, the peroneal, anterior tibial, and toe extensor muscles in the left foot were paralyzed. The left Achilles' reflex was absent. The patient walked with a steppage gait on account of the left drop-foot. There was pain on extending the left thigh on the abdomen, and he was unable to sit up after lying down because of pain in his back.

Surgical exploration. The laminæ and spines of the twelfth dorsal, of all five lumbar, and of the first sacral vertebræ were removed. These laminæ were three times as thick as normally, the bone being very spongy, vascular, and soft, with considerable bleeding. The spinal canal was found to be narrow, particularly in the region of the second lumbar vertebra, and the hypertrophy of bone was also most marked at this level. Above and below, the hypertrophy gradually diminished, extending perhaps not more than one vertebra above and below the second lumbar. The conus and cauda equina were somewhat œdematous and congested.

The patient had had backache for many years. The more recent increase of symptoms seemed dependent on stress and strain on the vertebral column, and was relieved by complete rest. His first severe attack of pain followed the jolting and shaking of a 30-mile ride on a tractor. The second appeared spontaneously, but the last and most severe attack, from which the anterior tibial and peroneal weakness resulted, was preceded by an undue effort in lifting a sick relative from bed.

So far as the history went, the case might have been one of spondylitis, consequent on trauma and with severe root pain. The relation of pain to posture and exertion, as evidenced by the fact that standing, walking, and lifting made it worse, while rest relieved it, might also indicate disease of the spinal column. The sudden paralysis of the dorsiflexors and evertors of the left foot might also be explained on that basis, but it is an unusual complication. It was the appearance of a yellow spinal fluid and the slow response of its flow to jugular pressure that led us to assume a block in the spinal canal, and advise exploration. Roentgenologic examination was of little value, the findings being negligible, or within normal limits.

Case 4. Mr. N. A., aged 23 years, came to the clinic July 2, 1924. His chief complaint was pain in the back and weakness of the legs. He had had tonsillitis every winter up to February, 1924. Twelve months before coming to the clinic, he had noticed a smarting, burning, dull pain in the lower lumbar spine. He also had an intermittent, momentary, sharp, pinching pain in the right testicle two or three times a day. Ten months before, the pain which had originally occurred only in the daytime, extended into the night and lasted until midnight or later. It was worse on coughing, sneezing, taking a deep breath, or jarring his spine. It was worse on active labor, but he could get almost complete relief by lying on a flat, hard surface. Lying on a soft bed caused sufficient pain to awaken him at night. Seven months before examination, he had noticed weakness of the left foot and diminution in sensation in the posterior part of the calf and ankle. At that time, the backache began to radiate down the back of the thigh into his calf and ankle. The weakness in the left foot, at first slight and only noticeable when he caught his toe in a rug, increased so that he became unable to dorsiflex his foot at all. Three months before, pain began to radiate down the back of the right thigh to the ankle, and the muscles of the leg below the knee became weak. Sensory changes appeared in both lower extremities, and ascended on the posterior aspect of the thighs to the buttocks around the anus and genitals. This disturbance of sensation was slight in comparison to the weakness. There was no sphincteric disturbance. All the symptoms were progressive and the pain kept the patient awake at night, unless a hard bed was available.

The patient was an apparently healthy young adult with a rigid lumbar spine. Spinal puncture at the fourth lumbar interspace produced a yellow fluid without any response to jugular compression. The pressure was 7.5 centimeters of water. Puncture in the tenth dorsal interspace and in the cistern produced a clear fluid with a good response to jugular compression, and a mean pressure of 19 centimeters of water. The Kolmer test in the fluid was negative; the Nonne test was positive, but there was only one small lymphocyte. It was difficult to get the needle through the intervertebral space in the lumbar region.

Neurologic examination revealed very marked weakness of all muscles below the knee, as well as of the glutei. There was corresponding wasting, lack of tone, but no fibrillary tremors. He walked with a marked steppage gait. Tendon reflexes were reduced in the upper extremities, and the patellar reflexes were more so, although some response was preserved. The Achilles' reflexes were absent, as were the abdominal, and the cremasteric reflexes were diminished. There was no Babinski sign. Sensory changes were slight, and subjectively, diminution of pain, thermal and tactile, extended as high as the eleventh dorsal segment, although there was no absolute anæsthesia. Vibration sensibility was much more reduced over the ankles, knees, and crests of the ilium. Joint sensibility was, however, preserved.

Surgical exploration. Operation was performed August 16, 1924. The spines and laminæ of the tenth, eleventh, and twelfth dorsal, and first and second lumbar vertebræ were removed. The laminæ were very markedly thickened, spongy, and vascular, and there was a narrowing of the spinal canal, most marked at the twelfth dorsal vertebra, where it was almost completely obliterated. The dura was very much thickened, rough in outline, and congested.

Fig. 1. (Case 4.) Roentgenogram of the spine, lateral view. Both the outline and shape of the vertebral bodies are normal.

Fig. 2. (Case 4.) Roentgenogram of spine, anteroposterior view. There are slight changes in the vertebral discs, but on the whole, little is to be seen.

It was not opened. The narrowing of the spinal canal was sharply limited to the region of the twelfth dorsal vertebra.

Here again posture seems to influence the patient's pain. Walking, working, and any movement tending to jar the spine made the pain worse, and relief was obtained by lying flat on a hard surface, so that the minimal strain was placed on the diseased spinal joints. It is relatively common for patients with spondylitis to complain of pain when lying on a soft bed, where the spine can sag, because, as the muscles relax during sleep, the tender surfaces of the vertebral joints are rubbed together, leading to sudden crises of pain, which waken the patient. Patients with a spinal cord tumor will get up out of bed and walk the floor, sit up in a chair, or make certain movements which they find relieve the pain, but this patient found that any movement of his spine increased the pain; the degree of pain was dependent on the amount of movement to which he subjected the vertebral column.

Roentgenologic studies in this instance helped to exclude gross vertebral disease, such as Pott's disease, or sarcoma of the spine. The findings were meager, and confined to a slight hypertrophic lipping of the lateral edges of the vertebræ, and a narrowing of the intervertebral space, which indicated absorption of the intervertebral discs (Figs. 1 and 2).

The neurologic findings were hard to explain satisfactorily. The patient had a marked weakness of the muscles below the knee, supplied by the fourth lumbar to the second sacral segments; on the other hand, muscles supplied by some or most of these segments, like the psoas, glutei, and rotators of the thigh, were comparatively little affected. The sensory disturbance was not in proportion to the motor loss, and the sphincteric control and sexual power were not impaired. Such a dissociated lesion might be explained on the basis that the roots were more involved than the cord. The cord was, however, markedly crushed at the level of the twelfth dorsal vertebra, and medullary tissue is supposed to

be more vulnerable than root tissue. The canal was sufficiently narrowed to produce a block in the circulation of the cerebrospinal fluid. The demonstration of this block by combined cistern, dorsal, and lumbar puncture had satisfactorily proved the block to be somewhere between the interspace of the tenth and eleventh dorsal vertebræ and the interspace of the third and fourth lumbar. The intervening length of spinal canal was not too great to preclude surgical exposure. The yellow fluid below the block was additional evidence, and laminectomy was advised chiefly on account of this block and the reasonable presumption that the disease process would proceed to the point of complete destruction of the conus medullaris.

CASE 5. Mr. W. S., aged 29 years, first came to the clinic February 2, 1922, complaining of pain down the posterior aspect of the left thigh, leg and outer side of the foot. He had had influenza 3 years before, and following this and undue physical exercise, he developed a dull, aching pain in the area supplied by the sciatic nerve, at first present only in the daytime. This became progressively worse, and continuous, being so intense at night that the patient was unable to sleep. For a month, he had walked the floor every night to get relief, and had frequently slept in a chair. Three months before, while practising the broad jump, he slipped but did not fall; however, in saving himself, he wrenched the lumbar spine. Following this, pain was greatly increased, and a numbness developed over the back of his thigh and the outer side of the left foot. Scoliosis also developed, the head and shoulders tilting to the right.

The patient was a well built man with definite scoliosis. Roentgenologic examination of the spine revealed nothing abnormal. The spinal fluid was clear and colorless; the Nonne test was positive, with seven small lymphocytes. There was slight tenderness over the second and third lumbar vertebræ, and flexing the head onto the chest produced a pain radiating down the posterior aspect of the left lower extremity. There was no definite sciatic tenderness, but Lesague's sign was positive. He had a well marked hypæsthesia to pain, and to tactile and thermal stimulation in the areas supplied by the first, second, third, and fourth sacral segments on the left side. The left Achilles' reflex was absent.

Surgical exploration. Operation was performed February 10, 1922, and a chondrofibroma, 1.5 centimeters in diameter, was found arising from the intervertebral disc between the fifth lumbar and first sacral vertebræ. It was situated to the left of the median line, compressed the fifth lumbar root, and narrowed the spinal canal to one-third of its normal diameter. It was completely extradural.

Following operation the patient did well, and left the clinic free from pain. However, the hypæsthesia persisted, and also slight weakness of the flexors of the toes on the left side. He returned 18 months later, complaining that the pain had recurred. Eight months after the operation, he had had soreness and pain in the left calf, with weakness of the left foot for 2 weeks. Nine months after operation he had resumed his former athletic feats. Seventeen months after the operation, or a month before his second visit, pain developed at the lumbosacral articulation, and within 2 weeks radiated down the left thigh to the outer side of the leg and foot. The slight residue of his former weakness increased, and the pain caused loss of sleep. The patient found that pain was greatly increased by sitting upright.

The sensory disturbance was more intense than at the previous examination, but the area involved was the same. There was definite weakness of the left calf muscle, and flexors of the toes, and pressure over the lower lumbar area of the laminectomy would produce pain radiating down the lower extremity.

The site of the former operation was explored August 24, 1923, and considerable overgrowth of bone was found to have taken place in the cut edges of the laminæ of the fifth lumbar vertebra, so that the caudal roots were more compressed on the left side. There was no recurrence of the tumor, the compression being anteroposterior, from the bony hyperplasia. This was removed; as a result the canal was widened, and pressure on the nerve roots was relieved.

Examination September 25, showed marked improvement in both sensory and motor functions, with slight residual findings. The patient was free from pain, and able to move his spinal column freely without pain or discomfort.

The history of this patient is very interesting, since pressure symptoms on the cord developed following operation for fibrochondroma. This is the only case in our series of 200 laminectomies for cord lesion in which secondary symptoms due to an overgrowth of bone developed following laminectomy, and it is fair to assume that his physical exertions and consequent trauma were not only of etiological significance in the formation of the fibrochondroma, but also were an etiological factor in the production of excess bone formation on the cut ends of the laminæ, narrowing the spinal canal and producing secondary symptoms.

CASE 6. Mrs. P. L., aged 49 years, gave a history very similar to that in Case 5. She had had recurrent attacks of pain in the lower lumbar region and

right sciatic distribution for 6 years; it was worse at night. This pain later involved both lower extremities with slight weakness and paræsthesia on the right. The pain was so marked that she became incapacitated for a time; then she improved, but later had a recurrence of very sharp, severe, bilateral pain. Laminectomy with section of the spinothalamic tracts was advised. This had been done 3 months before the patient came to the clinic. The spines and laminæ from the sixth dorsal to the fourth lumbar vertebræ had been removed. No tumor was found, and the left spinothalamic tract was severed. The pain was not relieved.

Neurologic examination here revealed sensory disturbance on the left, below the fourth lumbar segment, partially due perhaps to previous surgery. On performing lumbar puncture, however, spinal block was found to be present, and the question arose whether a tumor could have been overlooked. Because of the persistence of this block, exploration was advised. Just prior to performing the laminectomy, 2 cubic centimeters of cerebrospinal fluid were removed from the fourth lumbar space, and air substituted; severe pain down the posterior aspect of both thighs resulted, and burning pain over a band-like distribution below the umbilicus. On removing the air, the pain was relieved. The laminectomy consisted of an exploration of the previous laminectomy wound, and from the seventh dorsal to the third lumbar vertebra, revealing hypertrophy of the bone with a narrowing of the canal, and pressure on the cord opposite the ninth dorsal vertebra. The canal was not only narrowed laterally, but anteroposteriorly, and at the site of the former operation. It was, therefore, difficult to secure as much exposure of the cord as was desired. We could not help but feel that the hypertrophic osteitis had existed at the former operation, and accounted for the symptoms from the onset.

Case 7. Mr. C. J., aged 48 years, came to the clinic June 4, 1923. He complained of difficulty in walking and loss of sexual power. Four years before, he had noticed a sharp, stabbing pain in the lower lumbar spine when lifting heavy weights. This had increased so that his efficiency as a laborer had diminished. Three years before, this disability was sufficiently great to warrant his leaving his work for 10 months and resting. Thereafter he had noticed a slight weakness of his lower extremities, not sufficient to alter his gait, but causing his ankles to twist under him unexpectedly. Until 18 months before coming to the clinic, the weakness and the backache were not sufficient to prevent his working part time as a laborer in a coal mine, but he had only 50 per cent of his normal efficiency, and could not do any heavy lifting. Eighteen months before, he had suddenly experienced a severe cramping pain in the lower lumbar spine, which radiated down the posterior aspect of his lower extremities into the calves. This pain was extreme and continued for 16 hours; at the end of that period, he found he was paralyzed from his toes to his hips, and that there was a corresponding loss of sensation. His genitals were hypæsthetic, and his sexual power lost. There was, however, no sphincteric disturbance. The pain had never again been so severe as at the time when he became paralyzed, but on unusual exertion, turning in bed, coughing, sneezing, or jarring the spine, it returned. It was always relieved by rest. The paralysis almost immediately commenced to diminish, and within 8 months of the onset, he could get around on crutches. Six weeks before coming to the clinic, he discarded these, and could get around with a cane. Three weeks before, the ability to climb stairs had returned.

At the time of examination, he complained of being unable to raise his feet high enough to avoid his toe catching in the ground, and of residual numbness and loss of sexual power. His backache was sufficient to make him move cautiously, and required plenty of rest to avoid severe pain.

The patient was a well developed man, who walked with the aid of a cane. Both the blood and spinal fluid Wassermann reactions were negative. There was no pleocytosis in the fluid, and there was a prompt increase in spinal fluid pressure on squeezing the jugular veins. The fluid was colored a faint yellow. Roentgenologic studies of the spine revealed nothing abnormal. Neurologic examination showed a weakness of the thigh muscles, which was slight except for the hamstrings. The peroneal, anterior tibial, and extensor muscles of the toes were almost completely paralyzed, especially on the left side, but the calf muscles were normal. There was a corresponding atrophy in the paralyzed muscles, but no fibrillary tremors. The greatest disability was below the knees, and in the muscles of dorsiflexion and eversion of the foot. Sensory changes were present and severe. On the anterior aspect of the left thigh (first and second lumbar segment), there was anæsthesia to pain, temperature, and touch; that of the right thigh was normal. On both sides the skin below the knees, the posterior aspect of the thighs, the buttocks, the perianal region and the genitals were hypæsthetic. This hypæsthesia varied from severe to complete loss of pain, temperature, and touch sensibility. The perianal area and the genitals were less involved. To sum up, on the left, the whole of the lumbar and sacral distribution of sensation was involved; but on the right, only the third, fourth, and fifth lumbar, and all the sacral segmental skin areas were involved. Vibration and joint sensibility in the lower extremities was severely altered, so that the patient was very ataxic; this added to his bilateral drop-foot, and gave him a peculiar ataxic and steppage gait. The patellar reflex was absent on the left side, and diminished on the right; both Achilles' reflexes were absent. The anal reflex was preserved in spite of the disturbed sensation. There was no marked rigidity or limitation of the lumbar spine, nor any tenderness.

Surgical exploration. Operation was performed June 14, 1924, and the spines and laminæ of the twelfth dorsal, first, second, third, and part of the

fifth lumbar vertebræ were removed. The bone was thickened, spongy, and vascular. The spinal canal was found to be so narrowed as to compress the roots of the cauda equina opposite the fourth lumbar vertebra into a band. On the left side, the cord and roots were adherent to the dura, and the lumen of the canal was almost obliterated. The clinical appearance was similar to that in fractures of this area which compress the cord without severing it; that is, the cord, nerves, and roots were all adherent, and compressed to the extent that the cord became involved and a block was produced. The patient's convalescence was uneventful for 21 days, when he died very suddenly, following a stabbing pain in the chest which, we felt, was due to a pulmonary embolus. Permission for necropsy was not obtained.

The patient was a Lithuanian, unable to speak English, and the history had to be taken through an interpreter. The patient was a coal miner, subject to frequent injuries of a minor type, but was never actually incapacitated by one. It was difficult, therefore, to evaluate his symptoms. The spinal fluid was yellow, which indicated a partial block in the circulation of the cerebrospinal fluid. This, and the early history of weakness in his lower extremities, progressing slowly up to the point of the sudden exacerbation of pain and paralysis, suggested a compression lesion. The progressive improvement was hard to explain, but the disability still remaining after 18 months, was sufficient to warrant exploration. In certain features, this patient's disease resembles that in Case 4: preservation of bowel and bladder control, and the motor weakness almost entirely below the knees, and varying markedly in muscles supplied by the same or neighboring segments of the spinal cord. Thus, the calf was almost intact, while the peronei and anterior tibial muscles were paralyzed. The sensory disturbance in this case was much more marked, and the maximal amount of narrowing was lower in the spinal canal than in Case 4.

At the time when the patient became paralyzed, there was probably a sudden exacerbation of the osteo-arthritis, with pouring out of epidural periosteal exudate, and crushing of the nerve roots at the intervertebral foramina and in the canal. The cord could not have been greatly damaged since good control of the sphincters remained. Some of the inflammation must have subsided; on the other hand, some of it became organized, leaving a permanent narrowing of the spinal canal. Corresponding to the degree of insult, there was a partial recovery of nerve structures damaged by the compression, and the patient came to the clinic during the period of improvement. How far it would have gone is hard to say, but the surgical exploration revealed a condition not likely to clear up quickly.

Case 8. Mr. E. R., aged 17 years, came to the clinic November 29, 1923. Four months previously, he had developed a swelling over the right supraorbital region which went on to suppuration and abscess formation. This area was drained by multiple incision, and pus was evacuated. Nineteen days after the onset, left hemiplegia developed, and 2 days later generalized convulsions. For the 3 months preceding his visit, the patient ran a fluctuating temperature, and had another general convulsion. The right eye became more and more swollen, and the globe protruded. Roentgenologic examination revealed extensive destruction of the bones, and the diagnosis on admission was osteomyelitis of the skull with epidural abscess and proptosis of the right eye.

For 11 months this patient was under observation and care. There were periods of fluctuation in his condition, when new sinuses would appear over the scalp and forehead, and there was a constant profuse discharge of pus. Six weeks prior to laminectomy, he began to complain of a band-like pain around the thorax at the level of the third dorsal segment. Following this, he developed a numbness in the lower extremities which ascended gradually to the level of his pain. He developed a progressive paraplegia within 6 weeks, and there was a complete anæsthesia with a sharp level at the third dorsal segment. Spinal puncture was made, and yellow fluid was obtained which coagulated spontaneously. There was no response to jugular compression, and the fluid was full of polymorphonuclear cells, too many to count accurately. A cistern puncture revealed clear fluid above, with no increase in cell count, and there was a prompt response to jugular compression. Roentgenologic examination of the dorsal spine revealed nothing unusual. There was no marked tenderness, deformity or œdema of the skin over the spine. On account of the evidence of a compression lesion of the cord, with obvious block at the level of the third dorsal segment, exploration at that level was advised.

Surgical exploration. The spines and laminæ were removed from the second, third, fourth, and fifth dorsal vertebræ. The principal obstruction was found opposite the fourth. The canal was narrowed by the hypertrophied, cancellous, vascular bone which had compressed the cord to the extent of

complete block (Fig. 3). On opening the dura, the cord was found to be densely adherent to the dura, obliterating the spaces between the pia mater and the arachnoid. This mass was split dorsally, and small yellow bodies, 1 millimeter in diameter, were encountered along the periphery of the cord. These were irregularly placed, and while the center of the mass was perfectly red in appearance, the substance containing the yellow bodies was grayish blue, giving the impression that they were miliary tubercles in inflammatory tissue. The incision was about 5 to 6 centimeters long, but was not carried to the extreme limits, as we did not wish to open up the subarachnoid spaces to obtain cerebrospinal fluid.

In this case there was more evidence of an inflammatory process involving vertebræ, meninges, and cord, than in any of the others. The operative findings were sufficiently similar to include the case in the series, and although there was no actual suppurative process, hypertrophy, porosity, and vascularity, seen in the other cases, were present. Since the paraplegia had developed rapidly, it was our impression that an osteomyelitis of the spine had developed, or that a localized abscess had arisen. The bony changes might be taken as suggestive of similar pathological processes in the other cases, although an inflammatory focus was not so clearly demonstrated.

GENERAL CONSIDERATIONS

Seeing one case like the foregoing was enough to excite interest in the condition, but eight such cases were observed at the clinic between August, 1923, and November, 1924. This comprised sufficient clinical material to make valuable an inquiry into the factors governing the disease.

All of the eight patients had received complete clinical and laboratory examinations, and surgical exploration was resorted to in each instance. The data acquired afford an interesting study, and there seems to be a definite clinical syndrome established, with certain diagnostic features and indications of appropriate treatment.

Age and sex. All of the patients were male adults, and, with two exceptions, of good physique. Five were accustomed to hard manual labor, and the risks incident to it. Three were in the second, two in the fourth, and two in the fifth decade of life.

Duration and course of the disease. It would be hard to establish the actual onset of the disease, since some of its symptoms are extremely common to all grades and classes of people. For example, a backache is so frequent a complaint that no adequate idea can be reached as to when a particular pain later represented the onset of severe trouble. As soon, however, as symptoms of cord or root compression were established, there was a fairly rapid progress in the severity of the symptoms, and from that time until surgical exploration was undertaken, the course could be easily followed. In one patient (Case 7) complete paralysis from the hips down took place within a few hours, and in another (Case 3), a drop-foot developed in an equally short time. In three patients (Cases 1, 2, and 4), paralytic cord and root symptoms had been progressing for 12, 4, and 7 months, respectively, crippling them so that they were incapacitated for active work. Apparently, once the process of cord or root compression is established, it progresses fairly rapidly, and is a matter of months rather than of years.

Location. With the exception of the sacrum, any part of the spinal cord seems susceptible to this disease. The lumbar area seems particularly susceptible, since it was in this location that five patients noted suffering. In three patients the disease was in the dorsal area, and in one the cervical spine was attacked.

SYMPTOMS

Spinal. The symptoms of disease in the spinal column were by no means prominent in any of the patients. In most of them any complaint referable to the bony and joint structures was dominated by the involvement of the nervous system. In no single instance was there a suggestion of a widespread spondylitis, such as one sees in institutions that take care of chronic crippling diseases. In a few patients, it was not even suspected that the disease was primary in the spinal column, and secondary in the nervous system. Moreover, the symptom of backache is as common in primary compression lesions of the cord as in secondary lesions due to bone disease. The pain was, however, somewhat different from that associated with cord

tumor, in that it lacked the spontaneity so often seen in this disease. Pain independent of movement or posture was absent. There was no history of pain relieved by movement in any case, and the story of walking the floor at night to relieve pain was singularly absent. Case 5 presents a fine point of differentiation in that, while the patient had a tumor pressing on the nerve roots prior to the first operation, and complained of spontaneous pains at night after this operation, when an overgrowth of bone in the fifth lumbar lamina occurred, his complaint was chiefly of a postural pain that was worse on sitting up right, and was relieved by taking the weight off his spinal column. However, in all the cases, there was no complaint of deformity of the spine, or of interference with breathing due to fixation of the costovertebral joints. Root pain rather than bone pain was the rule.

Neurologic symptoms. As has been mentioned, the neurologic symptoms were predominant in the presenting complaint. The patients sought relief from root pain, from paralysis of the muscles of one limb, from inability to walk, or, as in the case in which the cervical cord was involved, from weakness of an upper and lower extremity on one side. Sphincteric disturbance was absent or slight in all, but complaint of diminution of sexual power was made in two.

PHYSICAL SIGNS

Spinal. Evidence of disease of the vertebræ was not prominent in the usual physical examination. With such severe neurologic signs one would expect more rigidity of the spinal column, which is the cardinal point of diagnosis in spondylitis. It may also be present to a severe degree in cord tumor, although never to the same degree as in spondylitis. In no case in this series was there complete rigidity of the spinal column with kyphosis. The findings at operation in Case 2 were a complete surprise in that, at no time during the examination was there any rigidity of the cervical spine, or any spasm of the muscles of the neck. There was no tenderness of the vertebræ. In the other cases, however, there was some spinal rigidity, and local spinal tenderness was specifically mentioned in two, but not to the same degree as in spondylitis. Moreover, the same tenderness may be present in cord tumors. In Bailey and Casamajor's cases, signs of spinal disease were more marked. In one case there was marked scoliosis, pain and muscular spasm pulling the body to the right, and in another there was severe pain on walking, or with any movement jarring the spine. A history of spinal injury 18 years before, with more recent signs of cord compression due to bony overgrowth, was present in a third case.

Neurologic symptoms. In the literature on chronic osteo-arthritis of the spine, little mention is made of gross damage to the cord or roots. Usually, however, reference is made to root pains. These may be bilateral or unilateral, and confined to one or more segments, or spread over a wide area of the trunk, the severity varying in location. Local muscular paralysis has been seen, and exaggeration, inequality, diminution, or absence of tendon reflexes are signs frequently mentioned.

Disturbance of sensation, such as paræsthesia, zonal hyperalgesia, and hyperæsthesia receive attention, but anything like the gross anæsthesia seen in our cases or those described by Bailey and Casamajor seems uncommon. On the whole, in the ordinary cases of chronic spondylitis, focal compression lesions of the cord or roots leading to severe neurologic signs are not as common as in destructive bone lesions, such as Pott's disease and malignant disease involving the spine. One of Bailey and Casamajor's five patients had a paraplegia dolorosa of three years' duration, with a sensory level at the twelfth dorsal segment. There was also diminution of reflexes, and disturbance of the center for erection in this patient. Their second patient had a weakness of the thighs and pelvic girdle muscles, without sensory disturbance or loss of sphincter control, and in the fourth patient there were irregular areas of anæsthesia without motor or sphincter disability. The fifth patient had a compression lesion of the cauda equina, due to bony overgrowth. Their cases, therefore, represent an extremely varied group. In our patients the lesions were, on the whole, just as varied. The patient with involvement of the cervical region had a clear

Brown-Séquard syndrome, and the patient in whom the dorsal area was affected, had a transverse level of anæsthesia without corresponding motor change. In the group of five patients with involvement of the lumbar and sacral cord or roots, the clinical picture varied with the extent of the lesion, but sphincteric disturbance was not marked in any of them, and the lower sacral roots were spared to a surprising degree. In two patients the lesion was slight and involved one or two roots only, with more marked motor than sensory change. In the others, in whom the cauda equina and lower cord were severely damaged, the distribution of muscular weakness was not uniform, but patchy. Some muscles were severely involved, and some seemed to have escaped. Whether the brunt of the damage was borne by the lower spinal cord (epiconus and conus), by the cauda equina, or by the spinal roots at the vertebral foramen, is difficult to determine.

Lumbar puncture. All of the patients had undergone this procedure, as an aid to diagnosis. In a few the results were surprising, and surgical exploration was undertaken on account of them. In most instances the jugular veins were compressed, while the needle was attached to a manometer, and the presence of a block in the spinal canal was estimated by the lack of response of the spinal fluid pressure to this maneuver (Quackenstedt test). The color of the fluid was noted, and the Nonne and Kolmer tests were applied to each specimen of fluid with a cell count. The pressure of the fluid was noted before and after jugular compression. In the case of the patient (Case 5), who had a tumor removed and returned with a bony overgrowth of the vertebral lamina, no lumbar puncture was made on his second visit. In five of the remaining cases, a yellow spinal fluid under low pressure was obtained, and there was no response to jugular compression in three of these. In two cases, there was an increase in cells in the spinal fluid. The Kolmer test was negative in all cases, but in three, the Nonne test was positive. Spontaneous coagulation was not noted in any case. As to location of lesion in relation to block, the patient who had a cervical lesion showed no such phenomenon, but it was evident in the two patients with dorsal lesions. Spinal block was present in only one of the three patients with lumbar lesions, on whom a lumbar puncture had been performed. In the patient whose only neurologic complaint was drop-foot, it is doubtful whether exploration would have been undertaken but for the obstruction of the spinal canal, as evidenced by the yellow fluid. Also, in Case 7, although the patient was improving slowly, operation would not have been advised, except for the same evidence of cord or root compression.

Roentgenologic examination. One might imagine that in the case of massive bony disease with hyperplasia and overgrowth found at operation, the roentgenologic findings would be of great value. As a matter of fact, the only value they possessed were to exclude destructive bony disease, such as Pott's disease, tuberculosis, syphilis, and cancer. Such positive findings as were present were slight, and gave no idea of the actual change present. In many persons accustomed to hard labor, exposure, and trauma, and in persons beyond middle age, some change in the outline of the vertebræ and vertebral joints might be expected. Actually they may be present and be symptomless. In senility, such changes are the rule. In cases of cord tumor, associated findings of hypertrophic arthritis and osteitis are extremely common, and seem of no diagnostic importance. The findings in the majority of our cases were so slight, and in view of the foregoing facts, seemed of such minor importance, that we gave them little consideration. Further, in cases of spondylitis, the bone and joints may show gross pathological alteration roentgenologically, but no evidence of severe cord compression. Bailey and Casamajor had much the same experience. In two of our patients the roentgenologic findings were completely negative, and in the others, absorption and calcification of the intervertebral discs, small bony overgrowths from the margins of the vertebræ, and haziness in detail of the margins of the vertebræ and transverse processes were noted. In lateral views of the cervical and lumbar spine, no alteration in its conformation could be detected, while in the

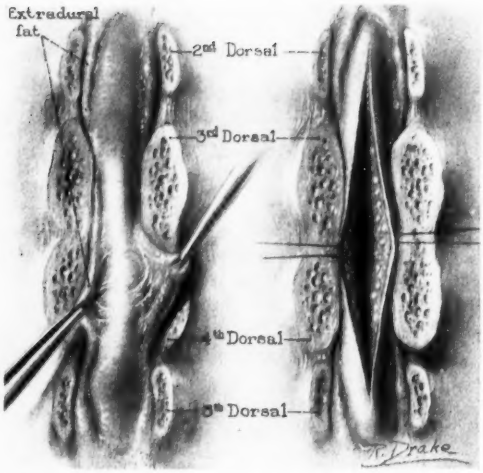

Fig. 3. Hypertrophic osteo-arthritis involving the third and fourth dorsal laminæ with associated inflammatory disease of meninges and spinal cord.

spinal canal such alteration was vaguely outlined.

In uncomplicated cases of hypertrophic osteo-arthritis, the findings are similar. In the early stages, when the symptoms are acute, no change in the bone may be demonstrated roentgenologically. It is only when the process has been present a long time, and permanent ankylosis deformity and bony change have occurred, that roentgenologic studies are of value. Severe pain and tenderness may have ceased. Probably the overgrowth of bone in the early stages is soft and contains little calcium, making it invisible in the roentgenogram.

PATHOLOGY

It is, indeed, difficult to classify the disease process present in these patients, since the whole subject of chronic spondylitis is confused and difficult, and inasmuch as the pathological alteration in these cases differs from that in the average case of chronic inflammation of the spinal column. There is little need here to discuss the difference between the types of chronic spondylitis described by Marie, Strumpell, Bechterew, Léri, and others. The fact that so many different names are used, such as spondylitis deformans, spondylose rhizomelique, chronic ankylosing spondylitis, and chronic hypertrophic osteo-arthritis, illustrates the lack of agreement as to essential character and definition of such diseases. For convenience, the name chronic hypertrophic osteo-arthritis has been used in this paper, but we are far from assuming that this is the correct term, or that it fully covers the whole disease entity.

Recently, Nathan, after experimental work with dogs, and a review of the previous discussion concerning the part the central nervous system plays in chronic hypertrophic osteo-arthritis, came to the following conclusions. In all cases of osteo-arthritis of the spine, there is more or less irritation of the nerve roots by the periradicular exudate thrown out by the inflamed periosteum of the spinal canal and intervertebral foramina. This irritation may be severe as compared to local joint signs and neurologic signs, such as local root pains and muscular paralyses; hyperæsthesial changes in tendon reflexes may result. The joint signs may clear up, and the neural remain, or vice versa. In some of Nathan's animals, there was a semi-solid opaque epidural exudate of irregular extent; in one case it extended from the median dorsal to the lumbar region. The vertebral veins were congested, and the vertebral periosteum thickened, with softening of adjacent bone. Nathan explains satisfactorily the cause of the diffuse neurologic signs in the ordinary case of hypertrophic osteo-arthritis of the spine, but his discussion does not include such gross focal compression and damage as was observed in our series. Were it only a matter of degree, some analogy might be suggested, but the neurologic symptoms were not merely severe, but also focal. Moreover, surgical exploration each time showed a limitation of the process to a few vertebræ, which was just as would be expected from the clinical findings. The local vertebral change without marked involvement of the spine elsewhere was the unusual feature in our cases. There was a marked overgrowth of soft, spongy, vascular bone of from one to four vertebræ, with thickening of the laminæ and narrowing of the spinal canal at one focal point. The microscopic study of the bone re-

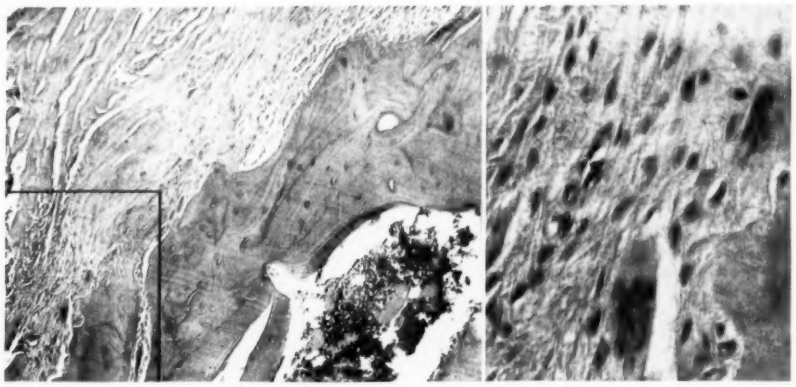

Fig. 4 (left). (Case 1.) Increased vascularity and inflammatory reaction of bone marrow. Thickening of periosteum and an increased number of osteoblasts.
Fig. 5. (Case 1.) Proliferation of periosteum, an increased number of osteoblasts, and two giant cells are shown in the microscopic field.

moved at operation might suggest an inflammatory process. There was an inflammatory reaction in the marrow spaces and proliferation of osteoblasts with active formation of new bone on the surface. The periosteum was thickened and œdematous, and there was an increase in the vascular supply to the tissue (Figs. 4 and 5). Two of Bailey and Casamajor's patients had had a history of infections of joints other than those of the spine, and there was an active suppurative process in one of our cases at the time spinal symptoms developed. There was a history of joint pains in Case 1 of our series, previous to the development of paraplegia, but in the other six cases no definite history of infection was elicited.

Trauma might be invoked as a contributory cause, and one of Bailey and Casamajor's patients had evidently injured the spine many years before the development of bony overgrowth. One of our patients (Case 5) had had a laminectomy, and, contrary to the usual rule, there was a bony hyperplasia in the cut edges of the laminæ in one of the vertebræ. The fact that five (62.5 per cent) of our patients were strong, muscular men, accustomed to hard physical labor, and exposed to repeated mild trauma to the spine, especially the coal miner, might indicate this as a predisposing factor. Actual chronic osteo-arthritis is a disease more common in the laboring classes than in the leisure classes. Possibly both infection and trauma are factors, the former being the more common and prominent cause of the disease.

DIFFERENTIAL DIAGNOSIS

We have already indicated that it is not easy to be sure of the actual nature of the disease in these patients prior to laminectomy. Since they presented histories of pain, motor disturbance, sensory levels and spinal block, surgery had been advised with the presumption of finding a cord tumor, and, instead of a cord tumor, a hypertrophic osteitis was found which had produced the level symptoms. In view of our experience, certain points seem to distinguish hypertrophic osteitis from cord tumor: (1) The type of pain in the former is more often secondary to posture, movement, or exertion, and not spontaneous as in cord tumor. It is usually relieved by rest. It may be nocturnal, but then due to posture, and the patients do not tend to leave their beds and walk the floor. (2) Signs of local spinal disease, which cannot be entirely accounted for by irritation of the nerve roots by tumor may be present. Extreme tenderness of the spinal column, pain on jarring the vertebræ, and deformity with muscular spasm may be observed in cases of tumor, but are not so common. (3) A bilateral equal paralysis of radicular distribution with preservation

of segments lower down, and without sphincteric disturbance is perhaps more suggestive of spondylitis than of cord tumor. The irregular character of the muscular paralysis in the lower extremities might seem to help in differentiation, except that an ependymal cell glioma involving the cauda equina will produce the same picture. Certain muscles may be severely involved, and others remain intact, both in chronic osteo-arthritis, and in the large irregular gliomatous tumors that fill the sacral and lumbar canals.

Altogether, a distinction between cases of cord tumor and chronic osteo-arthritis is difficult to make, and in certain cases one may well be in doubt. The roentgenologic examination, while it does not help to distinguish spinal cord tumor from chronic osteo-arthritis, does help to rule out syphilis and tuberculosis of the bone, since the vertebral bodies are seldom altered to the same degree as in the disease in question. Metastatic carcinoma, sarcoma, primary and secondary, and local bony tumors are easily differentiated roentgenologically, as are old fractures and rare diseases like echinococcus cyst, involving the vertebræ. The progressive history of the disease, its focal character, and the severe root pains are all signs indicating a compression lesion of the cord, and if the possibility of destructive disease of the bone has been eliminated, surgical exploration seems indicated even though the diagnosis is doubtful.

SUMMARY

Eight patients were seen in the Mayo Clinic between August, 1922, and November, 1924, who were suffering from a compression of the cord or its roots, due to hypertrophic osteo-arthritis. In all of these, the lesion was focal in character and confined to from one to four vertebræ. In one patient, the cervical, in three patients, the dorsal, and in four, the lumbar portion of the spine was involved. The disease may be due to an infectious process of the bone, to trauma, or to both. The symptom and signs were as a whole very similar to those in cases of extramedullary tumor of the spinal cord, but the pain produced by the disease was less spontaneous, and more influenced by posture, movement, and exertion. Roentgenologic studies were of value only in excluding other diseases.

In five patients a yellow fluid was obtained on lumbar puncture, and in three there was no change in the spinal fluid pressure on compression of the jugular veins. A partial or complete block in the spinal canal was diagnosed in 6 cases, and verified at operation.

The pathological process was limited to a relatively few vertebræ. It consisted of an overgrowth of soft, spongy, vascular bone, inflammatory in character, and producing a marked narrowing of the spinal canal. This localized bony overgrowth was the most marked feature in the whole series, and although the name "hypertrophic osteo-arthritis" is used, the bony changes were out of proportion to any joint disease.

Although it is difficult always to make a differential diagnosis between hypertrophic osteo-arthritis (hypertrophic osteitis) and cord tumor, one should at least endeavor to recognize and localize the level and the pressure on the cord, since both cord tumors and hypertrophic osteitis require surgical intervention. The immediate results following decompression laminectomy have been very satisfactory, but sufficient time has not as yet elapsed to give a definite statement regarding the ultimate prognosis.

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THE MECHANISM OF EPIDIDYMITIS[1]

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EPIDIDYMITIS secondary to infection of the posterior urethra and seminal vesicles develops as a result of extension of the process through the lumen of the vas deferens.

Extension of the involvement by way of the lymphatics to the epididymis has not been demonstrated either clinically or experimentally. It is impossible for infection to travel by this route, because the lymphatics of the vas deferens drain into the inguinal and hypogastric region (8) and do not extend all the way to the epididymis.

Although it is possible for organisms to be carried along the sheath of the vas, extension of the infection by this route does not often occur and it is doubtful whether epididymitis ever develops in this manner. Funiculitis is, in a large number of cases, an evidence of infection along the sheath of the vas from the vesical neck. Actual rupture of the distended seminal vesicle allows the contents to pour into its sheath. Incision of the funicular abscess may show the pus to be outside the apparently normal vas. This would indicate infection along the sheath.

That the organisms are not carried along the mucosa of the vas by continuity of the process, as from the anterior to the posterior urethra, is readily shown by the clinical as well as experimental evidence of the rapidity of the onset of the epididymitis and by the absence of involvement of the mucosa except at certain isolated areas.

All evidence points to the lumen of the vas as the path of infection. Epididymitis can be produced experimentally by allowing infectious material to pass up the ejaculatory duct (6). Following an epididymitis some pathology may be found in the intima of the vas but none about the vas. The rapidity of involvement and suddenness of onset also indicate this as the route of infection.

The actual mechanism of extension of infection along the lumen of the vas has, however, not been definitely determined. The vas deferens when stimulated undergoes true peristalsis from the epididymis to the posterior urethra. Peristalsis of the vas undoubtedly occurs during coitus. This peristaltic action of the vas was first demonstrated by Fick (4) in 1856 and since then confirmed by others, in recent years by Waddell (10) and Macht (7). Lommel has shown that stimulation of the hypogastric nerves or irritation of the verumontanum produces active peristalsis of the vas toward the posterior urethra. None of the investigators have been able to note a peristaltic wave in the opposite direction toward the epididymis. The work of Low and Oppenheim claiming reverse peristalsis of the vas has not been confirmed.

It has been shown (6), however, that when fluid is injected into the vas and the vas then stimulated, the fluid progresses backward by gradual stages toward the epididymis following each peristaltic wave toward the posterior urethra and in this manner finally enters the epididymis. This mechanism is somewhat similar to that of bladder reflux, and is most likely the manner in which epididymitis develops.

If the peristalsis of the vas ceases, the foreign substance is arrested within the lumen of the vas in its regression. This may account for the frequency with which strictures of the vas are encountered when vasotomies are being performed in men who have never had an epididymitis. The organisms probably were arrested on their way to the epididymis and implanted themselves on the mucosa with the resultant inflammatory reaction, later organization, and scar formation.

Lommel (6) noted that bacteria will not pass up the ejaculatory duct from the posterior urethra if the verumontanum is normal but that infection extends up the ejaculatory duct when the verumontanum is inflamed or congested.

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Belfield (2) has shown that it is possible to have urine pass through a needle in a vasotomy wound with a patulous relaxed ejaculatory duct. Most writers agree that mechanical irritation, trauma, or inflammatory œdema of the verumontanum is necessary for the extension of the infection through the ejaculatory ducts.

This discussion is particularly concerned with the mechanism of the extension of the process after it has reached the tail of the epididymis. We have evolved what appears to be a fairly clear understanding of the mechanism of the epididymitis based upon an observation noted in the past by others but to which no particular clinical significance or importance has been attached. In attempting to inject fluid into the epididymis through the vas deferens, we have found repeatedly that it is impossible to force any of the fluid much beyond the tail of the epididymis irrespective of the degree of pressure exerted or the length of time this pressure is applied. Neither low continuous pressure nor sudden high pressure made any difference in this finding—nothing could be forced beyond the tail of the epididymis. Our results were the same in the dog, bull, and ram as well as the human.

It may be well at this time to review some of the more salient features in the anatomy of the epididymis, for they have a distinct bearing, I believe, on the mechanism of extension of the infection.

The epididymis as it lies on the posterior surface of the testicle is somewhat crescentic in shape and about 5 centimeters long. It is closely invested by the tunica vaginalis except at the head and tail and is attached to the testicle, particularly at both ends. Beginning at the conus vasculosus, it is a single tubule very much coiled and twisted upon itself and is continued at the globus minor as the vas deferens. The coils of the tubule are held firmly together by areolar connective tissue. At the head a number of these coils are grouped and banded together by the connective tissue producing a compartment-like formation. The entire epididymis except the tail is, in fact, blocked off into a continuous compartment of coils directed toward the vas. At the tail, however, this compartment formation ceases, the coils becoming separated from each other although still held firmly together by the areolar tissue.

The tubule itself, if unwound, would measure about 20 feet in length. It is about 0.4 millimeters in diameter except at the tail where it is much thicker, approaching very closely the size of the vas. The tail compares with the rest of the epididymis as does the large to the small intestine. The tubule is lined with ciliated epithelium and has a muscular coat of longitudinal and transverse fibers. The junction between the lower part of the body and tail is quite irregular, the tubule here, as stated above, separating out as a single coil, and at this point making a number of acute angles upon itself. At this point the tubule also becomes much larger and thicker. The vas deferens meets the tail of the epididymis at quite an acute angle.

The tail of the epididymis is a development from the wolffian duct, together with the vas deferens, seminal vesicle, and ejaculatory duct (5), the body and head having been developed from the wolffian body.

A number of possible factors may be mentioned, one or all of which may have some bearing on the fact that it is impossible to force fluid up the epididymis:

1. The epididymis is a closed tubule containing secretion from the testicle that cannot very well be pushed back through its narrow lumen and cannot be made to back up.

2. The convolutions of the epididymis are directed toward the vas and any attempt to force fluid up the epididymis would almost necessitate the unwinding of these coils in the other direction.

3. The junction between the lower part of the epididymis and the tail has a number of acute angles, and fluid before passing through would necessarily meet with this resistance. Sir Astley Cooper in his textbook published in 1841 (3) speaks of the difficulty encountered in injecting quicksilver into the epididymis and attributes this to the sudden turn the tube makes.

4. The walls of the tubule swell and kink upon themselves when distended and prevent the upward flow of fluid.

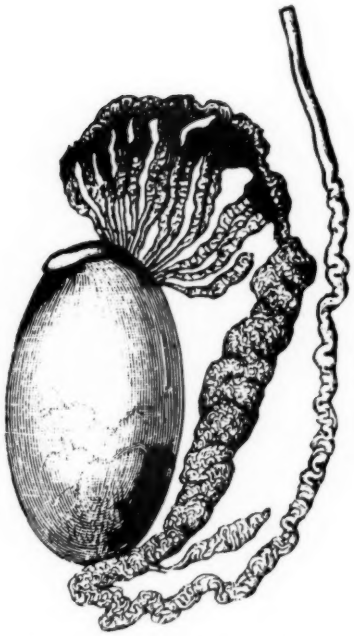

Fig. 1. Cut from Toldt's *Anatomical Atlas*, illustrating semidiagrammatically the human epididymis. The head and body of the epididymis show the compartment formation.

Fig. 2. Roentgenogram of the testicle and epididymis of a ram. The epididymis was injected under pressure through the vas deferens with a 50 per cent sodium iodide solution—none of the fluid got beyond the tail.

5. There may be valves at the junction of the body and tail.

Whatever the reason, fluid injected into the epididymis does not travel much beyond the tail.

We may now construct a theory of the mechanism of the development of an epididymitis secondary to infection of the posterior urethra and seminal vesicles. Although some of the conclusions arrived at still require proof and confirmation and may be disproved, our findings seem to us to form a basis for an understanding of the mechanism of epididymitis that corresponds well with the clinical facts.

With the involvement of the verumontanum during a posterior urethritis, organisms may be drawn in or carried up the ejaculatory duct. Normally the sphincter of the ejaculatory duct is in a tonic state of contraction. However, when inflamed it loses its tone and bacteria may enter and travel up. An œdema and partial or complete occlusion of the ejaculatory duct on the side affected now occurs. The seminal vesicle which has been infected or now becomes involved, has very little or no drainage through the swollen ejaculatory duct.

The organisms and pus in the seminal vesicle and ampulla increase in quantity and having very little or no means of egress are finally kicked back into the epididymis as a result of active peristalsis of the vas.

The dull pain and ache in the groin which usually immediately precede clinical evidence of epididymitis can probably be attributed to increased tension within the vas. We have attempted vasotomy at this stage in two instances but have not been able to prevent the development of the epididymitis, although we believe that with this procedure the extent of involvement was minimized. This apparently indicates that the epididymis is already involved at this stage but presents no symptoms previous to inflammatory reaction and tension within.

This pain in the groin as a rule disappears when the epididymitis becomes evident, the

infectious process having then locked itself within the tail. We have noted that when fluid is injected into the epididymis and then allowed to escape through the vas, it drains out very slowly, some of it remaining for a few hours. The inflammatory œdema that develops when the epididymis is infected occludes the tubule at the junction of the tail and vas within 24 hours for the added reasons that the junction here is at an acute angle, the tubule becoming convoluted and drainage being very slow at this point.

At the junction of the upper end of the tail with the body the upward extension of the process within the tubule becomes blocked as a result of the mechanical factors mentioned plus the inflammatory œdema within the tubule. In this manner the organisms and pus become locked within the tail of the epididymis.

The tension within the globus minor increases and the inflammatory reaction of the surrounding tissues becomes more marked. The bacteria are now carried through the intercellular spaces, lymphatics, and capillaries to the surrounding tissue, travel up, involve the rest of the epididymis by extension along the areolar tissue and peritubular tissue, and produce a peri-epididymitis rather than an epididymitis.

With increasing intensity of the infection and inflammatory reaction the tunica vaginalis both parietal and visceral, dartos and skin are also involved through direct extension of the process. Infiltration and involvement of the vas within the scrotum and inguinal region, which usually develops after the epididymitis has manifested itself, is probably due to direct extension from the tail of the epididymis.

With the subsidence of the involvement, the discharge as a rule reappears at the meatus. This may be due to the fact that the ejaculatory duct has again become patent, and the infected seminal vesicle can drain. What it most often indicates, however, is that the mobilization of the defense mechanism of the tissues has shifted from the epididymis to the urethra where bacteria are still present and pus is thereby again produced.

The reappearance of the discharge at the meatus does not indicate, however, that the epididymis is draining out through the vas and then the urethra, for the epididymis has in the vast majority of the cases become occluded because the tubule is destroyed, fibrinous exudate has become organized, and later scar tissue has formed. In those cases of epididymitis in which patency is restored this is due to the absorption of the inflammatory product. Within a few weeks all the tissues within the scrotum and the head and body of the epididymis return to normal. The tail, however, remains hard and infiltrated, this infiltration being permanent and can be felt months and years following an epididymitis.

A number of findings may now be mentioned that are apparently contradictory to our conclusions that the process is particularly limited to the tail of the epididymis because of mechanical blocking of extension along the tubule.

1. The marked involvement within the globus minor merely indicates that the infection is most intense here and may well compare with an abscess or carbuncle in which there is marked involvement at the center and considerably less inflammatory reaction of the surrounding tissues. This accounts for the lesser degree of infection of the head and body and the other tissues within the scrotum rather than any mechanical factors. This also accounts for the rapid resolution to the normal of the rest of the epididymis except the tail where the organisms particularly localize themselves. However, if this is so, how can one account for the uniform intensity of involvement at the tail; because the globus minor is invariably most affected. If there are no mechanical factors preventing the upward extension of bacteria within the tubule during life as we have noted with fluid injected, then it would seem reasonable to expect that one would occasionally find the head or body of the epididymis most affected; but such is never the case in epididymitis secondary to posterior urethritis or vesiculitis—the tail is always most affected.

2. Sections of the epididymis during the acute or subacute stage show some, although relatively little evidence of infection within the tubule in the body and globus major. This finding does not necessarily contradict our con-

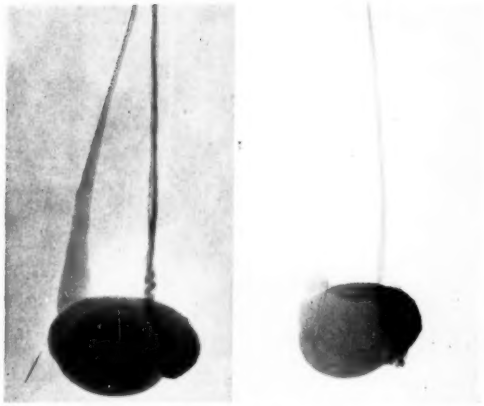

Fig. 3 (left). Roentgenogram of testicle and epididymis of a dog. Epididymis injected under pressure through the vas with 50 per cent sodium iodide solution—passage of the fluid upward beyond the tail was blocked.

Fig. 4. Same as Figure 3, showing intense shadow of the contrast fluid at the tail only.

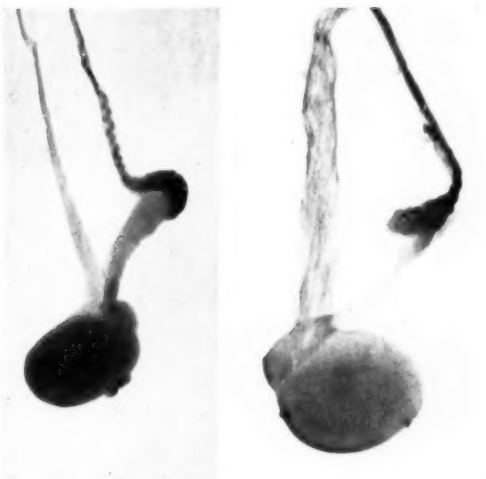

Fig. 5 (left). Testicle and epididymis of dog. The epididymis was separated from the testicle except at the globus major and then injected through the vas deferens with a 50 per cent sodium iodide solution as a contrast fluid. Nothing could be forced beyond the tail.

Fig. 6. Human testicle and epididymis with epididymis separated from the testicle except at head, as in Figure 5. As shown here no fluid could be injected beyond the tail of the epididymis.

tention that the spread of the infection beyond the tail is peritubular rather than intratubular. Since organisms may traverse the intercellular spaces of the wall of the tubule and be carried by the lymphatics and capillaries from within out, so also they may travel from without in, thus accounting for the slight degree of intratubular involvement at isolated areas in the body and head.

3. Abscess following epididymitis is most often found within or around the tail, or if outside the epididymis, approximately at the junction of the body and tail, indicating that here the extension upward intratubular was blocked and the tubule ruptured here. However, abscesses are sometimes seen at the head of the epididymis but they are nearly always outside the tubule and may be accounted for by the localization of the bacteria after they have traveled up the sheath. It is well known that many years after an epididymitis, when vaso-epididymotomy is attempted, sperm will nearly always be found in the globus major and very often in the body.

4. It is, of course, possible that our post-mortem and antemortem findings in which fluids injected into the epididymis resulted in blocking at the upper end of the tail, would not hold at all good for bacteria in the epididymis during life. In mild types of epididymitis the involvement limits itself entirely to the tail and the infiltration can be felt within the tail while the rest of the epididymis is apparently normal. If there is no obstruction to the upward passage of bacteria in these cases, why does not the entire epididymis become diffusely involved rather than the tail only?

SUMMARY

Epididymitis secondary to a posterior urethritis or vesiculitis results from extension of the infection along the lumen of the vas deferens, the mechanism here being the regression of the bacteria toward the epididymis following each peristaltic wave toward the posterior urethra.

Although no definite proof has been brought forth, it is most probable that bacteria are blocked in their passage up the epididymis beyond the tail, just as fluids are blocked experimentally, so that the bacteria involve the rest of the epididymis by peritubular extension and not intratubular extension, produc-

ing a peri-epididymitis rather than epididymitis of the body and head.

This may explain in part why it is that a gonorrhœal epididymitis is practically never an epididymo-orchitis but a pure epididymitis, the organisms not having traveled up the tubule of the epididymis beyond the tail.

This epididymitis rather than epididymo-orchitis may also be accounted for by the resistance of the testicle to the gonococcus. It may also be explained by the fact that the tunica albuginea being of a different structure than the tunica vaginalis arrests the extension of the infection to the testicle (1).

If our deductions are correct then epididymotomy is an operation that should be limited to the tail of the epididymis, for it is here that the process is intratubular. As performed at present it is more or less of a blind operation, the whole epididymis being slashed in many directions. Incision of the epididymis tubule does not increase the danger of occlusion as has been shown clinically and also experimentally with the vas deferens (9), because the epididymis undoubtedly has an equal regenerative capacity.

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AN ANALYSIS OF FORTY-ONE CASES OF THROMBO-ANGIITIS OBLITERANS

With a Report of a Case Involving the Coronaries and the Aorta

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From the Surgical Service (Dr. Neuhof) and the Pathological Department (Dr. David Marine)

THE purpose of this paper is to present an analysis of 41 consecutive cases of thrombo-angiitis obliterans studied at the Montefiore Hospital, New York. These cases were under observation at the institution for periods varying from 2 months to 10 years. Nineteen had the disease from 1 to 5 years; 14 from 6 to 10 years; 4 from 11 to 15 years, and 4 from 15 to 20 years.

FREQUENCY

Of 10,000 cases listed in the records of the hospital, 41 were cases of thrombo-angiitis obliterans, giving a percentage of 0.4.

ETIOLOGY

No etiological factor could be found. Previous infection apparently played no part. Syphilis did not occur in any of the cases; 36 gave a negative Wassermann reaction and 7 a plus minus reaction. Typhus fever (Goodman, 12) occurred in but 4 of 41 cases. Twelve gave a history of moderate use of tobacco (Meyer, 22; Wulff, 35), 24 of excessive use, 4 were non-smokers. Though all but 1 of the patients were Russian, Polish, and Rumanian Jews, no conclusions can be drawn from this fact since about 95 per cent of the patients at the Hospital are Jews.

Wieting (34) however reported cases among the Turks, Whyte (33) among the Chinese, Ludlow (20) among the Koreans and Koyano (16), Ito (14), and Todya (30) have seen it often among the Japanese.

SEX

All cases were in males. Isolated doubtful cases in women have been reported.

OCCUPATION

Though 10 patients were tailors every trade was represented.

AGE OF ONSET

The age of onset ranged from 20 to 45. The youngest case was that of a man of 20; 3 were under 25; 16 from 25 to 30; 5 from 30 to 35; 11 from 35 to 40; and 5 from 40 to 49. The greatest percentage occurred between 25 and 30 and the average age of onset was 32.5 (Fig. 1).

PATHOLOGY

The disease has been described under various names[1] by many earlier writers (Friedlander, 10; von Winiwarter, 32; von Monteuffel, 31; Dutil and Lamy, 7; Fraenkle, 9; Wwedensky, 36), but was erroneously believed to be a result of intima proliferation (Friedlander, 10) or arteriosclerotic changes (von Monteuffel, 31). Though Friedlander suggested the possibility that the obliteration was due to thrombosis, to Borchard (3) must be given the credit of establishing the thrombotic nature of the lesion. He definitely concluded that the process is one of primary thrombus formation in the peripheral arteries and veins with reorganization and recanalization and that it is distinct from arteriosclerosis. Buerger (5) has given a detailed description of the disease to which he gave the name of thrombo-angiitis obliterans and has established beyond doubt the thrombotic basis of the condition.

After amputation of a gangrenous limb in a case of thrombo-angiitis obliterans there was very little bleeding from the large vessels in the stump. Often the femoral artery was the size of a normal radial. The peripheral vessels, popliteal, and tibials were small, stiff and matted together by adhesions with adjacent nerves. The lumina of the vessels were narrowed or completely obliterated by grayish

[1] Gangran spontan, primary endarteritis obliterans, arteritis obliterans, obliterative arteritis of the young, arteriophlebitis obliterans, endophlebitis and endarteritis, presenile gangrene, non-syphilitic obliterative arteritis of the Jews, Tokuhatsu dasso gangræna spontanea (Japan), Buerger's disease, thrombo angiitis obliterans.

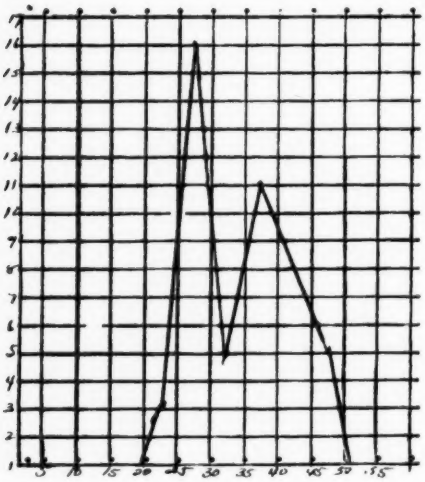

Fig. 1. Age of onset.

white thrombi. The dorsalis pedis artery and anterior and posterior tibials were most frequently affected. The more recent clot formation ended in a cone pointed cephalad.

Microscopic findings. In a review of the sections of 15 amputated extremities, the affected peripheral vessels showed all gradations from completely organized and recanalized thrombi to fresh clots. The most marked histological changes occurred in the intima with infiltration, thickening, and proliferation.

The adventitia showed very little change. There was often an infiltration with round cells and scattered plasma cells and occasionally fibrotic thickening.

The media was slightly thickened especially close to the internal elastic membrane where there appeared an infiltration of round cells. In general the muscularis media was unaffected. The internal elastic membrane was intact throughout, embraced the entire lumen as a uniformly thick, very wrinkled band. The invaginations sheltered accumulations of round cells. The internal elastic membrane was generally not thickened when unassociated with arteriosclerosis.

The intima. In the early lesion, the lumen was filled with a mass of fibrin and red blood cells, into which young connective tissue cells were growing from the intima. The endothelium was occasionally still present. This was probably a subacute stage and in such cases the cellular infiltration of the vascular coats was more pronounced.

Fig. 2. Case 3. The abdominal aorta from a fatal case of thrombo-angiitis obliterans. Recent thrombus formation in the external iliacs and abdominal aorta as far as the renal arteries.

In the older lesions, extending from the internal elastic membrane was a connective tissue mass, which completely filled the lumen of the vessel. The endothelial lining of the intima was indistinguishable. The ground substance had a hyaline appearance and invading it from the intima were fibroblasts and connective tissue cells, arranged in whirl-like accumulations. Many new small capillaries, lymphocytes, and plasma cells were scattered throughout the mass. Hæmosiderin pigment was present. The center of the tissue was perforated by a few small irregularly shaped endothelial lined spaces. The older healed lesions showed less cellular infiltrations and

denser connective tissue. Occasionally the recanalized vessels showed fresh clots in the lumen or complete closure resulting from fibrous constriction. By special staining Jores found an elastic membrane around the newly formed channels in the organized thrombus.

The veins showed relatively fewer changes. However, mural thrombi in the process of organization and fresh clots were more frequently in evidence than in the arteries. Many of the peripheral veins were thickened, narrowed, and occluded by the same process as the arteries.

The nerves. Early the perineural tissue showed cellular and fibrous tissue infiltration. In the later lesion the nerves in the vicinity of the vessels showed extensive fatty degeneration and fibrous replacement.

Arteriosclerotic changes were often associated with the disease. Four of the 16 cases studied pathologically had definite arteriosclerotic changes. The two diseases, however, are unrelated.

Buerger (5) described an "acute phase" with migrating phlebitis and cutaneous nodosities which he found in at least 20 per cent of his cases. Only 2 of our cases gave a definite history of this condition. The acute thrombophlebitis showing purulent foci of polymorphonuclear leucocytes with giant cells in the peripheral portions of the thrombus was not observed pathologically in any case of our series. Buerger termed this lesion "specific" for thrombo-angiitis obliterans. He found it only in the veins during an acute phlebitis. It has never been observed in the arteries.

SYMPTOMATOLOGY

Clinically the cases fell into three groups: (1) early type limited to the lower extremities without gangrene, (2) chronic type with gangrene of one or both lower extremities, (3) chronic type with involvement of upper and lower extremities. The cardinal symptoms were sensory, vasomotor, and trophic.

Pain was of several types. The intermittent pain and claudication that is so common in arteriosclerosis often occurred in these patients, as the only symptom for from several months to as long as 5 years before the appearance of other symptoms. The pain was generally in the calves (though it has been reported in the thigh) and probably resulted from vascular occlusion. Another type of pain was the sharp, excruciating, persistent pain localized under the nail of the toe or toes or at the seat of an ulcer. It was most intense when grangrene was impending and was amenable only to morphine. Sensations of formication, tingling, numbness, and other forms of paræsthesia commonly occurred. Reflex vasomotor phenomena of the superficial vessels secondary to the organic lesions in the deep vessels resulted in the early appearance of hyperæmia of the toes and dorsum of the foot associated with throbbing and burning; at first alternating with cyanosis, numbness, tingling and coldness, they were later replaced by them.

Infections and ulcerations were common and often initiated the gangrene. They frequently followed slight abrasions and were at times the first sign of the disease. Gangrene developed as soon as 3 weeks and as late as 14 years after the onset of symptoms, the usual duration being between 1 and 2 years.

Duration of symptoms before the development of gangrene or amputation:

	Cases
Less than 1 month	2
One to 3 months	7
Four to 6 months	8
Seven months to 1 year	4
One to 2 years	11
Two to 3 years	4
Five years	1
Six years	1
Seven and one-half years	1
Nine years	1
Fourteen years	1

The disease involved 2 or more extremities in 35 cases. In 7 all 4 were involved. The right lower extremity was affected first in the largest number of cases.

Though the disease was often progressive without any periods of improvement, remissions were common. In 10 cases there were no symptomless periods (all of these were less than 4 years in duration). The longest remission was fifteen years. The greater number were symptomless for 1 or 2 years of their course.

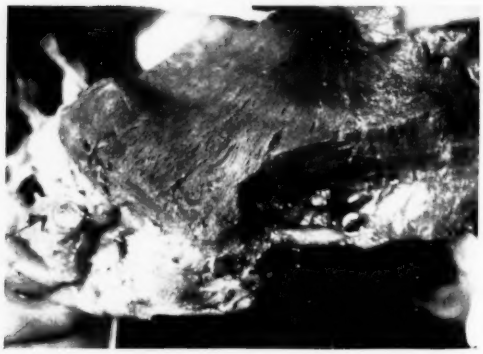

Fig. 3. Case 3. Showing an organized thrombosis of the left coronary artery.

Periods of remission:

	Cases
One to 6 months	8
Six to 12 months	3
One to 2 years	10
Three to 5 years	9
More than 5 years	5
Seven years	1
Eight years	2
Fourteen years	1
Fifteen years	2

Physical findings. In an otherwise healthy patient were found on local examination evidences of deficient circulation in one or more extremities. After the earlier stage of hyperæmia there were found in the affected extremity cyanosis, lowered temperature, blanching on raising the foot with slow return of color on lowering, and loss of pulsation of the palpable arteries. The dorsal pedal arteries, the anterior tibials, posterior tibials, popliteals and femorals were occluded in the order named.

In our series, the blood pressure was normal or subnormal. The average systolic pressure was below 125, in 7 it was below 110 and in 2 over 180. There was a difference in the pressure in the brachial arteries of the same individual in 16 cases varying from 5 to 40 millimeters systolic and 5 to 20 millimeters diastolic. The capillaries (Boas, 2), in 8 cases studied, showed no marked abnormalities and the capillary pressure was normal.

Blood chemistry. Blood sugar, blood urea nitrogen, and uric acid were within normal limits. Urine was negative in 34 cases, 6 showed traces of albumin; 1 had hyalin casts on several examinations.

COMPLICATIONS AND ASSOCIATED CONDITIONS

No specific complication other than gangrene occurred but the patients were subject to the same intercurrent diseases as any group of normal individuals.

	Cases
Moderate arteriosclerosis	5
Hyperthyroidism	1
Emphysema	5
Chronic bronchitis	1
Bronchopneumonia	1
Hypertension	2
Pulmonary tuberculosis	3
Hemiplegia	1

DIAGNOSIS

Thrombo-angiitis obliterans is generally not diagnosed early. Routine examination of the feet cannot be over emphasized. The characteristics of the disease are: occurrence in males in the late twenties in otherwise robust, healthy individuals without evidences of syphilis, diabetes or heart disease; frequency in Jews of Central and Eastern Europe and in Asiatics; onset usually in the lower extremities; development of signs of impaired circulation as intermittent claudication, paræsthesia, hyperæmia, blanching, and cyanosis; disappearance of pulse and difference in the blood pressure in the two sides; slow course of the disease, pain and intermittent claudication preceding gangrene by months or years; slow progression from one extremity to another involving one or more amputations; absence of symmetrical involvement; clinical remissions. The extent of the vascular lesion may in the future be determined by the X-ray. Berberich and Hirsch (1) inject a 10 to 20 per cent solution of strontium bromate directly into the artery after temporary ligation above the point of injection. Brooks (4) in this country uses sodium iodide. Both methods reveal the contour and lumen of the vessel. The patient must be subjected to both general and local anæsthesia for the injection is painful.

DIFFERENTIAL DIAGNOSIS

Loss of pulsations of palpable vessels, coldness of a part, paræsthesia and diminished active motion are signs of impending tissue

death from causes other than thrombo-angiitis obliterans. The disease must be differentiated from other conditions that cause gangrene. Gangrene due to an injury from without, resulting in destruction and thrombosis of the artery, thermal gangrene following extreme cold and prolonged exposure, resulting likewise in thrombosis, develop within 48 hours. Embolic gangrene secondary to myocardial disease is sudden in onset and offers little diagnostic difficulty.

In arteriosclerotic endarteritis obliterans with or without diabetes, the age of the patient is usually over 50; vasomotor phenomena, blanching and hyperæmia are infrequent; gangrene which here may be of the moist type, supervenes earlier after the first symptoms and progresses more rapidly; the physical manifestations of impaired circulation are few prior to the onset of gangrene; migrating phlebitis does not occur but marked varicosities of the superficial veins are more frequent. It is seldom found in the upper extremities. Arteriosclerotic gangrene is not limited to males nor to any racial groups.

Luetic endarteritis leading to the occlusion of the peripheral arteries of the extremities is extremely rare and can be differentiated from thrombo-angiitis obliterans only by the presence of other evidences of syphilis.

Periarteritis nodosa, an acute infectious disease with fever, nephritis, leucocytosis, etc., characterized by multiple focal thromboses and small aneurisms occurring in the arteries of the muscles and viscera may, in its early stages, present symptoms of severe intermittent claudication (similar to thrombo-angiitis obliterans), referable to a wider distribution of vascular insults. The disease occurs chiefly in men between 25 and 50 and is rapidly fatal, lasting 8 to 12 weeks (Lamb, 18).

Raynaud's disease is differentiated by sudden onset with local syncope or regional ischæmia involving the fingers, more rarely the toes, and occasionally the ears and nose; short duration of the sensory and vascular manifestations and their intermittent character; and symmetrical gangrene and absence of arterial occlusion between the attacks.

Acrocyanosis, a progressive, slowly developing asphyxia of the ends of the extremities with local hypæsthesia is generally associated with pulmonary osteo-arthropathy.

In erythromelalgia, a chronic localized hyperæmia with pain and swelling (probably not a distinct entity), there is no blanching when the extremity is raised.

Sclerodactylia and sclerodermia are generally symmetrical and though they may present vasomotor signs of asphyxia and syncope, they are characterized by shortening of the fingers due either to a contracture of the skin or absorption of the terminal phalanges recognizable by X-ray.

PROGNOSIS

The average life of the limb was 1 to 2 years after the onset of symptoms. There was no definite relationship between the duration of the disease, the number of the extremities affected, and the number of amputations. In 4 cases of less than 2 years' duration one or two extremities were amputated, in 4 cases of 3 years' duration there were no extremities amputated, in eleven cases of more than 10 years' duration three or four limbs were involved and there were two or three amputations. In general, the older the disease, the more extensive the destruction.

The duration of the cases in our series was from 1 to 20 years. One patient died of bronchopneumonia, 1 of pulmonary tuberculosis, 1 of sepsis following amputation.

There was 1 patient in this series whose death could be attributed directly to thrombo-angiitis obliterans of the aorta and coronary arteries. As far as can be ascertained no such case has been previously reported.

TREATMENT[1]

The treatment of thrombo-angiitis obliterans has, at best, been only palliative. Amputation is the only satisfactory symptomatic

[1]At a recent meeting (March 4, 1925) of the Harlem Medical Society, Dr. H. B. Philips read a paper entitled "Roentgen Therapy of Thrombo-Angiitis Obliterans" in which he recommended the use of the X-ray over the lumbar region of the back for its stimulative effect on the sympathetic. In a rather large series of cases treated and followed for as long as 14 months the results were definitely palliative. Many of the patients had a complete remission from all symptoms. It was particularly effective in the ulcers, healing them in a few weeks. In all probability this form of treatment will not affect the pathological process, and since remissions are characteristic of the disease, further observation of these cases must be reported before any evaluation of the treatment can be made. It is fairly evident that it gives some temporary relief, and ought to be tried cautiously. There is a definite but transient decrease in the coagulation time with the use of even small doses of X-ray, which, however, Dr. Philips insists has led to no deleterious effects. Dr. Philips' excellent contribution will soon be published.

treatment. The methods used for improving the circulation and diminishing pain are rest, baking, hot air (incandescent lamp) and diathermy, which afford some relief. Koga's (15) method of diminishing the viscosity of the blood by the use of hypodermoclyses of Ringer's solution has gained widespread support but has been found to be of doubtful value.

Steele (27), believing erroneously that the clotting time is shortened in thrombo-angiitis obliterans, advocated the intravenous injection of 2 per cent sodium citrate. MacArthur (21) recommended duodenal flushings. All these treatments are tedious and must be continued for months. Their effects are at best transient. They have no effect on the pathological process.

The use of typhoid vaccine has apparently afforded some temporary benefit. It was observed that during an acute intercurrent infection with fever the pain was definitely diminished. Goodman and Gottesman (13), attributing this to the reaction to foreign bacterial protein, introduced the use of typhoid vaccine (non-specific protein therapy) in the hope of mitigating the vascular spasm that is generally superimposed on the pathological process.

The injection of 95 per cent alcohol directly into the main nerve of the affected part has been abandoned by Silbert (26) because alcohol results in tissue necrosis. The use of epidural injections of small quantities of novocain in saline as recommended by Strauss (29) in his treatment of sciatica may ameliorate the pain. Morphine should not be withheld from these patients, for actually it is the one remedy that affords relief.

Ligations of the femoral vein (Oppel, 23; Lilienthal, 19) and arteriovenous anastomosis (Satrustegen, 25; Wieting, 34; Goodman, 11; Davies, 6) are mentioned only to be condemned as dangerous and unphysiological. Eto (8) and Stetten (28) in reviewing a large series of cases report over 70 per cent failures. Amputation is generally resorted to sooner or later.

The following tabulation shows the number of amputations performed in cases of thrombo-angiitis obliterans:

	Cases
Right leg only	15
Left leg only, amputated	55
Right and left leg	13
No amputations	4
Right and left leg and fingers of both hands	3
Right and left leg and left arm	1

CASE REPORTS

The following 3 case reports illustrate the significant features of the disease.

Case 1 is an early case of thrombo-angiitis obliterans limited to the lower extremities without gangrene. In this type, treatment may give fair results, but the condition is generally progressive in spite of all efforts to the contrary.

Case 1. 04118. H. G., a Russian tailor, 46 years old, a heavy smoker, with a history of apical tuberculosis 3 years prior to the present illness, entered the hospital, December 3, 1920. Onset was 4 months previous to admission with cramp-like pains in the calf muscles of the left leg on walking, relieved by rest. He complained of coldness of the toes and feet especially in winter and found great difficulty in keeping his feet warm at any time. At times he felt a burning sensation in the dorsum of the left foot. On physical examination, aside from a healed tuberculous condition in the left apex, he presented no systemic abnormalities. His toes were cyanotic and cold and the pulsations of the dorsal pedal and anterior tibial arteries on both sides were absent. The feet on being raised blanched readily, and the color returned very slowly when they were lowered. The blood pressure was 106–78, urine and Wassermann reaction negative. He received baking and 40 injections of Ringer's solution, 500 cubic centimeters at each injection, administered by hypodermoclyses. On March 30, 1920, he was discharged improved symptomatically although the physical findings were unchanged. When last seen 3½ years later, at the follow-up clinic, he had been free from severe symptoms for more than 3 years. He still got occasional cramp-like pains in the calves which compelled him to rest. He occasionally felt some coldness in the feet, but the burning sensation was gone. On physical examination both feet were cool, but rubor was present all over the toes and the plantar surface of the feet. When the leg was raised 45 degrees, the feet blanched but when it was lowered the color returned only after 20 seconds. The blood pressure was 112–80. The dorsal pedal artery, anterior tibial, posterior tibial, and popliteal arteries were not pulsating; the femoral pulsation was palpable on the right, but very weak on the left. Though the patient had apparently improved symptomatically, his condition was progressing. The patient was probably passing through a period of clinical remission. His fair condition cannot be attributed to the treatment.

Case 2 illustrates the chronic type, involving all four extremities with gangrene in the lower and upper extremities. This generally occurs in the cases of long duration though the upper extremities may be involved first. The patient in the following case was in the institution for 11 years.

Case 2. Schiff Pavilion. A. K., a Russian Jew, age 40, a heavy smoker, entered in November, 1912. In his youth he had a severe nasopharyngitis with a complicating double otitis media which has since left him deaf. One year prior to admission he had immersed his feet in cold water after a Turkish bath. From then on he felt sticking, burning sensations in both feet and found walking difficult. Pain was not very severe but 7 months later, gangrene of the toes of the right foot developed and his foot was amputated at the Presbyterian Hospital. Gangrene developed in the stump a few months later and his leg was amputated. Pain, coldness, and cyanosis developed in his left leg within a few months. When he entered this hospital he complained, in addition to pain, of tingling and numbness in both hands and foot. On examination he had signs of involvement in his remaining three extremities. His toes were cold and cyanosed. The anterior and posterior tibial arteries were pulsating. Both hands were blue and cold and radial pulsations though diminished were palpable. The lungs showed some emphysema, the heart showed no abnormalities. Pulses were equal and regular. The blood pressure was 115–80. Urine and Wassermann reaction were negative. Two years after the onset of illness and within a year of his admission, the left leg was amputated, because of the development of gangrene. For the next 3½ years he was free from all severe symptoms. Then the symptoms of tingling, pain, and coldness returned to the fingers of the right hand. The radial pulses completely disappeared. Within 4 months 4 fingers became gangrenous and were amputated. Then followed another period of relief for 4½ years. Four fingers of the left hand then became cyanotic and painful, and within a few months, the index, middle, ring and small fingers were amputated in the order named. For the next 3 years the left radial pulse was not palpable and for the past 2 years he complained only of tingling, burning, and numbness in both hands. When examined in February, 1924, thirteen years after the onset of this disease, both hands and stumps of fingers and the stumps of both legs were bluish. The right radial pulse was imperceptible but the left was barely palpable. The right brachial pulsated strongly, the left faintly. Neither femoral pulsations could be felt. Blood pressure, right, was 115–80; left, 90–68. His general condition was excellent.

The pathological report of the amputated extremities showed advanced lesions of thrombo-angiitis obliterans in the vessels. The peripheral arteries were completely occluded by recanalized thrombi; the walls were thickened, the intima being mainly involved; and the nerve fibers showed fatty degeneration.

This case illustrates the slow but certain progression of the disease from limb to limb. Nevertheless there were periods of remission of 3½ and 4½ years, a common finding in most of these cases.

In the following unique case the cause of death was thrombo-angiitis obliterans of the coronaries and aorta.

Case 3. H. K. (02993), was admitted to the hospital September 25, 1917. The family history was negative.

In the winter of 1900 the patient began to feel pain, paræsthesia and cold sensation in the left foot. This pain was followed by a bluish discoloration, confined to the big toe. The toe became infected and was amputated. Four months later pain and cold sensation was noted in other toes of the left foot which became bluish and gangrenous. All were amputated in 1901 at Bellevue Hospital where he remained for 4 months. The foot did not heal and there was a severe slough from it. Pain persisted and the gangrene spread. In January, 1902, a mid-tibial amputation was done which healed in 2 weeks. He was free from all symptoms in this leg for 15 years. About 7 months prior to admission, the entire stump began to pain and feel cold and became dark blue in appearance. This continued until June 8, 1917, when the entire stump became painful and gangrenous. At Bellevue Hospital the stump was amputated above the knee.

In 1902 the right leg began to show a condition similar to that of the left, paræsthesia, cold sensation and cyanosis and gangrene. In January, 1903, the leg was amputated in the upper third of the tibia. About 1914 the patient's right ring finger became painful and gangrenous and was amputated at the German Hospital. Later the entire hand became painful and the patient claimed that the condition was relieved by hypodermoclyses.

On admission he had pains in both stumps and a gangrenous patch in the right stump.

Physical examination showed a middle aged man of 44, with amputated lower extremities, complaining of severe pain in stumps. He slept in the sitting position on the left side of his body. There was cyanosis of the mucous membranes. The head, chest, lungs, and heart were essentially negative; the skin was dry; and the abdomen negative. The right hand had a purplish hue and became deeply cyanotic when lowered. When the arm was raised the entire hand rapidly became pale. The left hand showed the same changes. The right radial pulse was feebler than the left. The left leg was amputated about mid-thigh, the stump suppurating. The right leg was amputated at the mid-tibial region with ankylosed knee. Cyanosis was evident up to

the mid-thigh. At the end of the stump there was a large gangrenous area about 4 inches in diameter and very deep.

Urine and Wassermann tests were negative. The blood pressure varied between 115–90 to 135–92 while in the hospital.

Between October 2 and 21 the patient received 8 hypodermoclyses of 500 cubic centimeters each. The left stump healed partially.

On March 5, 1918, the right leg was amputated at the middle of the thigh, and healed with difficulty.

On January 27, 1918, the index finger of left hand was amputated.

On October 22, 1919, there was very little pain. The left stump had not entirely healed.

On June 5, 1920, patient's left thumb and forefinger became involved in a gangrenous process.

June 20, 1920, the left hand was amputated and the wound healed in 3 weeks.

October 19, 1920, the patient vomited twice, became cyanotic, and died suddenly within a few minutes.

Autopsy was performed by Dr. B. S. Klein 8½ hours after death.

Anatomical diagnosis. Thrombo-angiitis obliterans (organized, canalized thrombi) involved the arteries of all extremities including external iliac arteries and left coronary artery. There was recent thrombus formation in the external iliac arteries and aorta as far as the renal arteries, and gangrene of legs and hands. There were operation stumps on the upper third of each thigh, left wrist, and base of right middle finger. Myocardial scars (left). There was cardiac dilatation and hypertrophy. Passive congestion of the lungs and abdominal viscera were of short duration (1 month). There were evidences of acute dilatation of the stomach, and chronic pancreatitis. The probable cause of death was thromboangiitis obliterans with extension of the process from the iliac arteries into the aorta as far as the renal arteries. The heart weighed 470 grams. Measurements: tricuspid ring, 12 centimeters; pulmonary ring, 8 centimeters; mitral ring, 10 centimeters; aortic ring, 7¼ centimeters; right ventricle length, 3 centimeters; left ventricle length, 15 centimeters. It was considerably enlarged; the endocardium was thin and delicate; and there was a moderate amount of fat in grooves. The right auricle was moderately dilated; the tricuspid ring admitted four fingers; the ring was moderately stretched. The right ventricle was moderately dilated especially in conus. The pulmonary ring was stretched, the left auricle and ventricle moderately dilated. The myocardium on the left was moderately thickened. Mural and valvular endocardium throughout was thin and delicate. Coronary vessels: beginning 1½ centimeters from its orifice in the aorta, the main left coronary artery showed an organized canalized thrombus almost completely occluding the lumen for a distance of 1½ centimeters. The process here resembled that in the vessels of the extremities. The right coronary artery showed no abnormalities. On section the left myocardium and the muscle in general showed no appreciable abnormalities. There were, however, several depressed pearly-gray areas replacing muscle varying in size from a few millimeters to 1 centimeter in its largest diameter.

Microscopic findings. Myocardium, palely staining. Moderate fragments with definite localized areas of scar formation.

Lungs. All lobes voluminous, cushiony, soggy. Pulmonary vessels—no abnormalities. Bronchi—no abnormalities.

Liver. Moderately enlarged. Average consistency, capsule thin, surface smooth. On section lobulations regular. Tissue has a somewhat translucent appearance, suggesting œdema. There were scattered small yellow opaque flecks (fat). Gall bladder normal.

Spleen. Weighed 270 grams. Considerably enlarged, consistency about the average. Capsules slightly diffusely thickened. In addition there were two patches of thickening each several centimeters in surface diameter. On section soft but coherent pinkish-gray surface present. Malpighian bodies not unduly conspicuous. There was apparently moderate increase in gray pulp. Trabeculæ not appreciably thickened.

Microscopic findings. Malpighian bodies well preserved. Hyaline degeneration of arteries.

Adrenals. Not removed.

Kidneys. Together weighed 300 grams. Somewhat larger than average. Surface smooth except for scattered small depressions here and there. On section the cortex regular in width, averaged 7 to 8 millimeters. Striations everywhere regular. Glomeruli more prominent than average. The medullary tissue also more deeply colored than average.

Ureters and bladder not removed.

Microscopic findings. Tubules well preserved, general thickening of the vessels particularly involving the intima.

Neck organs not removed.

Blood vessels. Aorta—elasticity fair. There were scattered small soft yellow opaque and firm whitish plaques in the intima. The change was slight. The abdominal portion presented a striking picture. Beginning just below the renal arteries, there was a laminated, friable gray and red clot attached to the intima at the periphery, occluding the lumen. The clot was present throughout both iliac arteries, where it was soft, friable, red, and moulded to the wall. The external iliac arteries in their distal portions showed old organized canalized clots. Vessels of the upper extremities were not obtained.

Microscopic findings. Peripheral arteries—many sections showing all gradations from complete organization with canalization and calcification to freshly deposited thrombi. The most marked changes throughout appeared in the intimal coat associated with great thickening, ulceration, round cell infiltrations and marked hyperæmia of arterial wall (congestion of vasa vasorum).

Alimentary tract. Stomach greatly dilated. Mucosa congested, covered by moderate amount of tenacious mucous. Remainder of tract not removed.

Sections of pancreas. Moderate general fibrosis with islands of Langerhans reduced in size and number. Pancreatic lobules widely separated by fatty infiltration.

No doubt a careful follow-up of all cases of thrombo-angiitis obliterans will reveal more instances of such fatal complications. The possible association of coronary disease with this disease throws a new light on thrombo-angiitis obliterans.

COMMENT

The etiology of the disease is still a matter of speculation. The work of Rabinowitz (24) who claimed to have isolated the etiological organism has not been confirmed.

Though earlier writers (von Monteuffel, and others) confused the disease with endarteritis obliterans and believed premature arteriosclerosis to be the underlying factor, the thrombotic nature of the disease was already recognized thirty years ago by Borchard and later by Wwedensky.

Buerger's contention as to the specificity of the "purulent and giant cell" foci has been denied by Koyano (16) and Krampf (17), who claim to have found similar lesions in acute thromboses following infections. Since we find early and late lesions in the same extremity it is interesting that in no case of our series was Buerger's specific lesion seen in the vessels of amputated limbs. The disease may be considered as a prolonged chronic infection characterized by acute exacerbations. One would therefore expect to find in some of the vessels of the amputated extremity evidences of the "specific lesions" since the final occlusion is often due to an acute thrombosis superimposed on a chronic process. It is therefore of some significance that Buerger's so-called "specific lesion" is never seen in the deeper arteries or veins, the *primary* seat of the disease. The lesions described in the migrating phlebitis are in all probability *not* specific for thrombo-angiitis obliterans.

There can be little doubt as to the infectious nature of the disease as Buerger first indicated. The inflammatory reaction, round cell infiltration, etc., even in old lesions suggests this. Though an etiological organism has not yet been proved this seems to be the field of most promising research.

SUMMARY AND CONCLUSIONS

From an analysis of this series of cases the following conclusions are drawn:

1. Tobacco, typhus fever, or other previous infection play no part in the etiology. The age of onset is usually in the second or third decade.

2. The acute specific lesion described by Buerger is not found in the vessels of the amputated extremities. The deep arteries and veins in the affected limbs show various stages in the process of organization and recanalization of thrombotic lesions.

3. Acute phlebitis is an uncommon finding.

4. Patients are generally in good health aside from their local condition.

5. The extremity first affected is more often the right lower.

6. Gangrene develops generally within 2 to 5 years after onset of symptoms.

7. The disease is characterized by periods of remission from months to years in which the patient may be free from all symptoms.

8. The most important physical sign and indication of arterial occlusion is absent pulsation of palpable arteries of the extremities. This occurs months or years before the onset of gangrene.

9. The capillaries are normal.

10. Arteriosclerosis is sometimes associated with the disease.

11. All four limbs are often involved in the older cases. The cause of death is generally an intercurrent infection. Death from thrombo-angiitis obliterans of the aorta and coronary vessels may occur.

12. The disease must be differentiated from the other causes of gangrene principally Raynaud's disease, arteriosclerotic endarteritis, syphilitic endarteritis and from sclerodactyly.

13. The present treatment is unsatisfactory.

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DIATHERMY WITH METAL ELECTRODE AS A POSSIBLE ADJUVANT IN THE TREATMENT OF GONORRHŒA IN WOMEN[1]

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REPORTS on the treatment of gonorrhœal endocervicitis by diathermy have been so optimistic as to compel attention, and this research was undertaken in the department of obstetrics and gynecology at the University of Minnesota in the hope that, under this treatment, gonorrhœa in women might cease to be the stumbling block that it has been in the past. During the last 10 years we have seldom cleared up our cases in the out-patient department within 2 months, and frequently it has taken 6 months or longer. It was reported that under diathermy only a few treatments were necessary to stamp out the disease. These reports were not accompanied by proofs in the nature of numerous negative smears taken over long periods, but no doubt such checks were made.

At this clinic we have been unable to obtain such excellent results. We have made a study of more than 100 treatments and have checked them immediately before and after each treatment, by cervical smears stained by the Gram method. I have personally given these treatments and have checked every smear, and only those were called "positive" that contained Gram negative, biscuit-shaped, recognizably grouped, intracellular organisms, unquestionably gonococci. The largest number of treatments given in any individual case has been 20. These treatments have extended over a period of 3 months and, as yet, we have not been able to discharge 1 as cured. It is a disappointing showing but not an unusual one, if cures are based on proper microscopic evidence carefully obtained.

The rationale of diathermic action, briefly stated, is as follows: The tissues between the electrodes actually generate heat within themselves entirely apart from the actual heat in the electrode. That this phenomenon really obtains we proved by experiments on the anæsthetized dog. With large metal mesh electrodes on opposite sides of the thigh, the temperature at the femur, or approximately the middle of the thigh, could be raised in a striking manner. That this heat was not caused by the temperature of the electrodes themselves was demonstrated by taking the temperature between the electrodes and the skin and substituting water jackets of the same temperature. The temperature at the femur immediately lowered. There is no question of the heat-producing possibilities of diathermy within the tissues when large electrodes can be used. There is a great question, however, as to whether sufficient heat can be generated to kill bacteria within the deep tissues without injuring the superficial structures. Observations of experiments given later would prove that this is impossible; the relaxing and circulatory benefits of heat may be obtained but not the bactericidal results of higher temperatures. In the reports on diathermy in gonorrhœa it is the bactericidal action that has been maintained.

In this series of treatments the Corbus metal electrode was used in the cervix. This electrode is shaped like a straight, hollow sound, tapering at the end, and it contains a thermometer by which one can accurately measure the temperature of the electrode in the cervix. In the early treatments the indifferent sponge metal electrode was placed over the pubis or the sacrum. Later a belt of 4-inch mesh was substituted under the belief that possibly the diathermic action might radiate from the cervical electrode in all directions. This is purely theoretical. It would seem the most likely that the current would choose the path offering the least resistance to the exclusion of all other radii emanating from the cervical electrode. It is my opinion that this is what really takes place, resulting in an infinitesimal zone in the cervix subject to diathermy, the remainder of the cervix merely reacting to the actual heat in the electrode, as indicated by the thermometer within the electrode. Practi-

[1]Read December 18, 1924, at the meeting of the Minneapolis Clinical Club.

cably, the belt has proved more comfortable to the patient but the results have not been changed. In the early treatments a Corbus electrode 1⅞ inches long was used. Later this was shortened to ¾ of an inch because it was found that, as the temperature was raised, the internal os would relax, allowing the electrode to slip through with danger of extending the infection to the body. In 2 cases it was believed that extension occurred in this manner. The length of the electrode used should be changed according to the length of the cervical canal in each case in order to keep the electrode from entering the internal os. With these preliminary statements, let us go on to observations on the actual treatments and the results obtained.

In the first 25 treatments all other therapeutic agents, such as douches and topical applications of antiseptics, were eliminated in order that the results might not be clouded. The current was increased very gradually up to the point of tolerance of the patient and this current was maintained for from 30 to 40 minutes. In most instances the patients could not tolerate a temperature above 118 degrees F. in the Corbus electrode. It was soon learned that one must not depend upon the point of tolerance of the patient. Even 118 degrees F. almost invariably caused a slough, none of a serious nature, however. Many observations set the limit of temperature, with the ¾ inch electrode, that would not cause a slough at 45 C. or 113 F. As the gonococcus is supposed to die at a temperature of 108 F., this allows a lethal margin of 5 degrees, if the temperature in the electrode is any indication of the heat generated within the tissues. Experiments seem to prove that it is not a correct indication.

Now, what local signs and symptoms obtain during a treatment? As the current is increased the patient begins to complain of a dull ache or of cramp-like pains similar to menstruation cramps or a threatened miscarriage. The more slowly the current is raised the less marked are the symptoms, but the point is finally reached when the patient can no longer stand an increase in current. This point of tolerance was always far beyond the temperature which would cause a slough; therefore, one should be guided by the temperature within the electrode rather than by the pain tolerance of the patient.

During the treatment of 30 to 40 minutes a profuse cervical discharge is given off, sometimes as much as 4 or 8 cubic centimeters. This profuse discharge accounts for the marked difference in the appearance of the smears before and after treatment. Whereas the smears before treatment may contain innumerable bacteria of many kinds and the usual field of pus cells, some containing the gonococci, the smears after treatment are practically free from all extracellular bacteria and the pus cells are fewer in number and generally more or less broken down. In most instances pus cells could still be found containing the gonococci. When this situation is analyzed one will conclude that this does not mean that the cervix is sterilized but that the cervical canal is cleansed for the time being by the profuse discharge. If the organisms were there and dead from the heat their staining qualities would not be changed, as evidenced by flaming smears. That the organisms are still in the deep tissues is evidenced by the fact that, in 24 hours, the smears are the same as before the previous treatment.

The absolute failures of the first 25 treatments, from the standpoint of destroying the gonococcus, pointed to the conclusion that one would not be justified in withholding douches and topical applications. From then on diathermy was used to flush out the cervix preliminary to medication. For the past 3 years, based upon experimental evidence, we have been using a solution to cleanse the cervix preliminary to medication, this solution containing a half-and-half mixture of a saturated solution of sodium carbonate and peroxide of hydrogen. This mixture is prepared in each case immediately before its use. After its use, smears from the cervix show as clear as after the diathermy treatment. Its use is less time-consuming and less expensive to the patient. Theoretically, from the standpoint of the profuse discharge caused by the heat in the cervical canal and, possibly, the diathermic stimulation of the cells, it would seem plausible that diathermy might be a more efficient cleanser. This deduction is purely theoretical as we have

not tested the rapidity of the return of surface bacteria hour by hour after the two types of cleansing. As far as I can see, the results with diathermy as an adjuvant to the old form of treatment, with topical application, etc., are no better and no worse than the old form of treatment alone.

One case was instructive from the standpoint of the possible use of diathermy as a provocative agent. This case was one of a girl who was sent in for examination because she had been accused of infecting a boy. Clinically, the case was negative and she returned negative smears. As she was so normal in appearance she was chosen as a test case to determine the limit of temperature in the Corbus electrode which would not cause a slough. When she returned for observation, 2 days later, we were confronted with markedly positive smears. This instance is suggestive of the possible use of diathermy to float deep organisms to the surface, but only suggestive, as the smears might well have been positive without the treatment.

The application of silver nitrate is, as we all know, an excellent provocative agent and takes less time with less expense to the patient. When diathermy as a gonococcocide brought no results in the cervix where, as we know, the glands are deep, it was thought that possibly a cure could be effected in the urethra more easily. With the indifferent electrode over the pubis, the Corbus electrode in the urethra and the temperature in the electrode gradually raised to 112 degrees F., at which point most patients complained of discomfort, treatment was continued for 15 minutes. Several treatments failed to clear the smears of gonococci. It will occur to all that possibly the diathermic action here did not affect the posterior wall of the urethra, where Skene's glands are situated. To test the diathermic action the electrode was held close to the anterior vaginal wall against the urethra and a fever thermometer placed in the urethra. Distress rendered it impossible to raise the temperature of the electrode above 112 degrees F., when the thermometer in the urethra registered only 100.8 degrees F.

The same experiment was repeated on an anæsthetized bitch, in which animal the urethrovaginal septum actually measured only 2.5 millimeters in thickness. A temperature of 113 degrees F. in the Corbus electrode in the vagina for 30 minutes raised the urethral temperature to only 103.6 degrees F. A temperature of 140 degrees F. in the Corbus electrode, at which temperature the electrode actually singed the vagina and caused an œdematous burn under the indifferent electrode over the pubes, raised the temperature in the urethra to 106.8 degrees F. The dog had to be deeply anæsthetized to keep her from evincing marked evidence of distress.

If it takes a temperature of from 106 to 108 to kill the gonococcus, it would appear to be impossible to attain this temperature at a depth which would eradicate the deep organisms without superficial injury. This experimental evidence would account for the failure to eradicate the gonococcus from the cervix and urethra.

Postulating that possibly the size of the cervical electrode prevented the desired rise of temperature without cautery effects, Drs. A. D. Hirschfelder and R. N. Bieter of the department of pharmacology at the University of Minnesota conducted thorough experiments on the anæsthetized dog using large electrodes over large surfaces. They found that, even under such conditions, to obtain a temperature of from 106 to 108 degrees F. in the deep tissues, damage to the skin resulted.

CONCLUSIONS

1. Diathermy, with the metal electrode in the cervix, is not a gonococcocide to organisms in the deep tissues, at least with the use of amperage which can be borne by the patient from the standpoint of pain and which will not cause damage to the tissues.

2. Diathermy of from 30 to 40 minutes' duration, with the Corbus electrode registering 45 degrees C. or 113 degrees F., produced a copious cervical discharge which gives evidence, from smears, of having washed out the cervical canal and may thus be of value in preparing the cervix for medication.

3. It may be of value as a provocative measure before taking smears in doubtful cases.

4. An electrode long enough to enter the internal os, should not be used in the cervix,

because of the possibility of extending the infection.

5. The fact that diathermy sometimes produces colic-like pains resembling menstrual cramps or threatened abortion and that it frequently produces irregularities in menstruation suggests that it might be a dangerous treatment in pregnant women.

Brief case reports are given of 10 patients treated in the Dispensary of the University of Minnesota.

The method of treatment regularly followed consisted of the cleansing of the cervix with peroxide of hydrogen and sodium carbonate and the application of argyrol, 25 per cent, mercurochrome, 5 per cent, or silver nitrate 10 per cent, according to the chronicity of the condition. These reports bring out with great force the necessity of obtaining negative smears before pronouncing a case cured with any type of treatment. The cases must be cured both clinically and bacteriologically. It will be noted that in some of these cases treatment was stopped before cures were effected. Several of these patients were brought back by the Social Service Department and others disappeared and could not be found. During the time noted in the reports, no cures were effected.

CASE 1. M. A., No. 52845, noticed a slight discharge for 4 or 5 months. She was sent in October 21, 1924, accused of infecting a boy. Smears were negative. Diathermy was given October 23; regular treatment on the 25th; diathermy on the 29th, 30th, and 31st, when smears were positive. On November 3, smears were negative and diathermy was given. November 10, regular treatment was given, the smears were negative, and the patient was transferred to the Minneapolis General Hospital.

CASE 2. A. B., No. 46835. Gonococci had been present since February 16, 1924, and regular topical applications had been given up to August 9, 1924, when diathermy was tried and the smears were still positive. Regular treatment was given August 23 and 25, when smears were positive. Diathermy was given September 4, when smears were positive. Regular treatment was given again on September 9 and 16, and diathermy on the 23rd. The smears were still positive. The regular treatments, followed by negative smears, were given October 5 and 9. Diathermy was given December 4, and the smears were negative.

CASE 3. L. O., No. 47759. Smears were positive, June 7, 1924. Regular treatments were given on June 10, 12, 14 (smears positive), July 2, 9, 11, 14 (smears positive), 16 (smears negative), 18, 23, and August 4 (smears positive). August 6 diathermy was given, and smears were positive; there was a profuse watery discharge from the cervix. August 7 the flow began and continued with great pain. The tubes were removed at Minneapolis General Hospital on August 11, the diagnosis being bilateral chronic salpingitis.

CASE 4. I. M., No. 50587. July 24, 1924, gonococci were present clinically. After regular treatment, smears were negative. July 26 (smears negative) regular treatment was given. July 31 after regular treatment gonococci were present clinically but smears were negative. August 4 and 6, regular treatments were given and smears were positive. August 8 and 15 diathermy was given; smears were positive. September 2, 6 (clinically positive), and 13 regular treatments were given and smears were negative. September 20 and 27 regular treatments were given and smears were positive. October 11 regular treatment was followed by negative smears.

CASE 5. M. D., No. 50508, had had profuse discharge since July 7, 1924. July 21 regular treatment was given and smears were suspicious. On July 23 (smears negative), 25 (smears positive), 28, and August 1 and 4 regular treatments were given. August 6, diathermy was given and smears were negative. August 15 and 16, no treatments were given, as patient was very nervous. August 18 (diathermy), 23, 30 (diathermy), September 6 (regular treatment) and 13 (diathermy), and October 4 and 22 (diathermy), the smears were positive.

CASE 6. L. V., No. 51343. September 2, 4, and 8, regular treatments were given and smears were positive. September 10, diathermy was given and smears were still positive. September 11, regular treatment was given. September 12 (smears negative) and 15 (smears positive) diathermy was given. September 19 and 20 (smear positive), regular treatments were given. September 22 and 27 (diathermy), and 29 (regular treatment), and October 1 (diathermy), 3, 8, and 9 (regular treatments), the smears were positive. October 14, regular treatment was given and the smear was negative. October 16, diathermy was given and the smear was positive. October 17, regular treatment was given, there was sloughing, and the smears were positive. October 10, diathermy with belt electrode was used, and smears were positive. October 24 regular treatment was given, and smears were positive. On November 1 and 6, regular treatments were given. On November 3 a biopsy was made on the cervical slough.

CASE 7. G. C., No. 19675, May 12, 1924, showed clinically gonococcus to be present, but smears were negative. Regular treatments were given May 14 (smears negative), 17 (smears positive), 19, 21, 24, 26, June 2, 4 (smears negative), 6 (smears positive), 9, 11, 14, 16, 18 (smears positive), 20, 25, 30, July 2, 5 (clinical gonococci), 7, 10, 12, 14, 16, 18 (smears positive), 28, August 1 (smears positive), and 5. Diathermy was given, and smears found positive, August 7, 14, and 16. August 22, regular treatment

was given and smears were negative. Diathermy was given and smears found positive on August 25, 27, and 29. September 2, regular treatment was given and smear was positive. The patient left the dispensary and went under the care of a private physician.

CASE 8. J. B., No. 45503, began treatment December 21, 1923. Regular treatments were given December 24, 26, 28, 31, January 2, 1924, January 4, 7, 9, 16, 18. Regular treatments were given and negative smears found on January 21, 23, 25, 28, February 1, 29, March 3, and 26. May 6, regular treatment was given and the smears were suspicious. May 16, the regular treatment was followed by a positive smear. Regular treatments were given June 10, 16 (smears positive), 18, 20, 23, 25, 28, 30, July 2, 5, 8, 10, 12, 14, 16 (smears negative), 19 (smears negative), 21, 24 (smear negative), 26 (smear negative)August 6 (smear positive), with smears negative, August 13, 20, 27, 26, September 26, and November 6. On November 22 regular treatment was given and the smear was positive. November 24 diathermy was given and the smears were suspicious, and again on December 1 when the smears were positive.

CASE 9. I. B., No. 17870. Gonococci had been present since September 5, 1924. Regular treatments were given and positive smears found on September 5 and 17. Regular treatment was given on September 19. Diathermy was given and smears were found positive September 24 and 25. September 26, regular treatment was given and a slough from the cervix noted. September 27, regular treatment was given and slough smears gave positive culture. October 4 and 5 regular treatment with mercurochrome was given and a slough was found healing. Regular treatments were given October 8 and 9 (smear negative). October 16 diathermy was given and smears were positive. Regular treatment was given and smears were positive, October 17. Diathermy was given October 18 (smears positive), 21 (smears negative), 22 and 23 (smears positive). November 1 regular treatment was given and the slough was marked. November 3, regular treatment was given, smears were found positive, and the slough persisted. Diathermy was given November 5 (smears positive), and 7 (smears positive before, negative after). November 17, smears were positive. November 19, smears were positive and regular treatment was given. Diathermy was given November 21 (smears positive), 24 (smears positive), 25, 26, 28 (smear suspicious), 29 (smears positive), and December 1. December 3, regular treatment was given and smears were positive. Diathermy was given December 4, 5 (smears negative), 9 (smears negative before, positive after), and 10 (smears positive before and after).

CASE 10. C. S., 51805. Gonocci had been present since July 24, 1924. Smears were positive September 8 and 13. Diathermy was given and smears were positive on September 18, 20, 22, 23 (too much reaction for diathermy), 27, October 1, 2, 4, 6, 9, 10, 22, 28, 29. Smears were found positive September 24, 26, 29, 30, October 7. Smears were negative after diathermy treatment on October 30, and after regular treatments on November 13, 14, 15, 17, and 18. Smears were positive after regular treatment on November 19, negative after diathermy on 22nd. Regular treatment was given on November 25, and diathermy on the 28th. Treatment was discontinued because of severe pain, especially in an abdominal scar.

A CRITIQUE ON THE HISTOGENESIS OF HETEROTOPIC ENDOMETRIAL PROLIFERATIONS

By M. R. ROBINSON, M.D., F.A.C.S., New York

OUR knowledge of heterotopic endometrial proliferations dates back to 1860, when von Rokitansky first described adenomyoma as a pathological entity. For more than 30 years this subject lay dormant, and only after von Recklinghausen published the results of his studies made in 1893, 1895, and 1896, did the pathological world evince an interest in this problem.

Since then a vast literature has accumulated, but the origin and cause of endometrial growths still furnish a fertile field for speculative reasoning and academic discussions. With very few exceptions, all those who have followed this path of research up to the present have agreed that all these tumors originate during the process of embryonic development from displaced rests of the genito-urinary tract; but they differed quite decidedly as to which of these anlagen, whether the wolffian body and duct or the mucosa of the muellerian ducts, constituted the exact histogenetic source.

As the result of this controversy, two distinct schools have formed, and their teachings still influence the concept of the histogenesis of adenomyoma. What are the bases for these theories?

THE FUNDAMENTALS OF THE OLDER THEORIES

Accepting the dominant theory of displacement as a working hypothesis, von Recklinghausen saw in the close anatomical relationship between the ducts of the primordial kidney and the generative organs, sufficient ground for the possibilities of the transference of embryonal rests from one structure to the other. The muellerian duct (Fig. 1) lies to the outer side of the wolffian during the earliest period of embryonic development; later on it assumes an anterior (Fig. 2) and still later a mesial position to the latter, so that it may meet the opposite duct, fuse with it, and thus form the fallopian tubes, the uterus and the vagina. In the schematic cross sections represented in Figures 3, 4, and 5, these topical changes are more clearly seen. In Figure 3 the primitive urinary and genital ducts lie in a fold of tissue known as the plica urogenitalis. These folds gradually approach each other in a mesial direction (Fig. 4) and as they extend caudally, they finally unite in front of the pelvic colon (Fig. 5) and form a common cord containing the wolffian ducts and the fused muellerian ducts.

The crossing points of the muellerian over the wolffian ducts, and their close anatomical relationship during the embryonic period, constitute the keystone of von Recklinghausen's histogenetic theory. In addition to the embryological facts, von Recklinghausen has further adduced microscopic evidences to prove that these organoid formations simulate the component parts of the mesonephros by presenting the following morphological arrangements: (a) narrow straight tubules lined with ciliated epithelium analogous to the collecting tubules; (b) secreting tubules; (c) ampulæ, (d) end tubules; and (e) the fusion of many tubules to form main or principal canals. The stroma in which these tubules are embedded consists of a cytogenous connective tissue. Around the cystic glands the cytogenous tissue is scant, and their epithelium rests immediately upon the muscle bundles. The glands which showed an irregularity of their lumina due to a bulging inward of part of the circumference were regarded as pseudoglomeruli.

In summing up his observation von Recklinghausen stated: "The epithelial constituents of the adenomata and cystadenomata of the fallopian tubes, of their interstitial portions, and of the outer peripheral layers of the uterus are derived from rests of the wolffian body, while the centrally located adenomyomata of the uterus arise from the uterine mucosa, or its equivalent, the muellerian ducts."

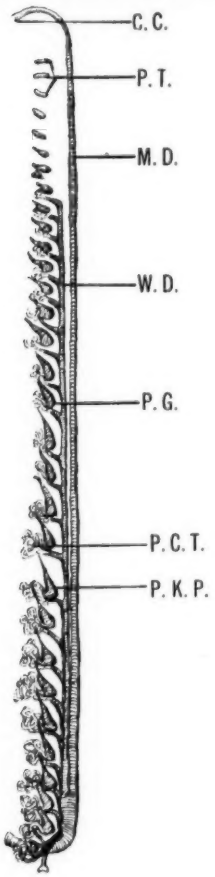

Fig. 1. Reconstructed primordial kidney of a female pristiurus embryo, 31 millimeters in length. *C.C.*, Opening of muellerian duct into cœlomic cavity; *P.T.*, primordial tubules at the cranial end during involution; *M.D.*, muellerian duct; *W.D.*, wolffian duct; *P.G.*, primordial glomerulus; *P.C.T.*, primordial convoluted tubules; *P. K. P.*, primordial kidney pelvis. (After C. Rabl.)

In 1897 Pick described his findings thus: "The arrangement of the glands in the organoid tumors resembles a goose-step formation, they contain pigment bodies, pseudoglomeruli, and collecting tubules, in other words, elements identical with those present in the mesonephros or pronephros." One year later, he described the histogenesis of adenomata of the groin and of the posterior vaginal wall, and he showed an inclination toward a belief in a dual genesis, for he stated:

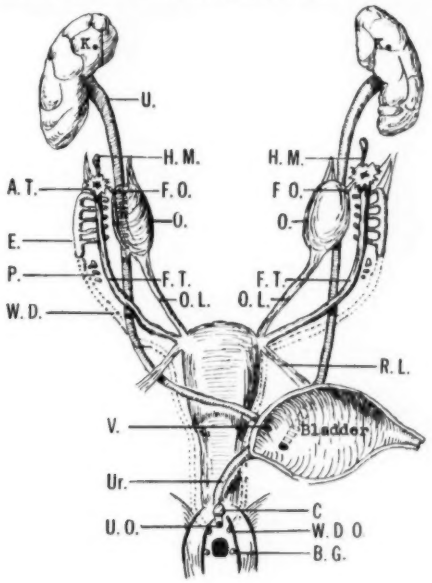

Fig. 2. A schematic drawing of the structural transformations of the internal genital organs of the female. *U.*, Ureters; *H.M.*, hydatid morgagni; *F.O.*, fibria ovarica; *O.*, ovaries, *F.T.*, fallopian tubes; *O. L.*, ovarian ligament; *A.*, *T.*, abdominal end of tube; *E.*, epoophoron; *P.*, paroophoron; *W.D.*, obliterated wolffian duct; *V.*, vesical end of ureter; *Ur.*, urethra; *U.O.*, urethral opening; *R.L.*, round ligament; *C.*, clitoris; *W.D.O.*, obliterated openings of wolffian ducts; *B.G.*, Bartholin glands. (After H. K. Corning.)

"The wolffian body and duct on one side, and the muellerian duct on the other, stand in such close developmental relationship to each other that we must ascribe the origin of the epithelium in the adenomata and cystadenomata to both sources. The adenomata containing cytogenous connective tissue are of muellerian origin, for this type of tissue is found only in the uterine mucosa, but thus far never in the wolffian body. Adenomata of the round ligament and of the posterior vaginal wall are of paroophoron origin, and are due to displaced distal rests of the wolffian body. The cervical adenomata arise from Gaertner's ducts, and must be differentiated from von Recklinghausen's paroophoric adenomata in the same way as adenomata of the seminal vesicles must be differentiated from tumors of the epididymis, of the vasa aberrantia, and of the organ of Giraldès."

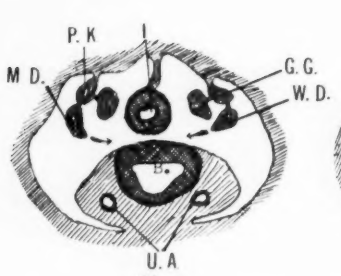

Fig. 3.

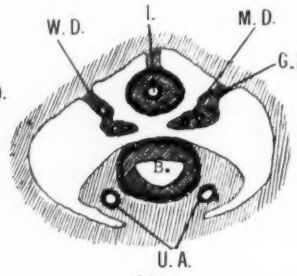

Fig. 4.

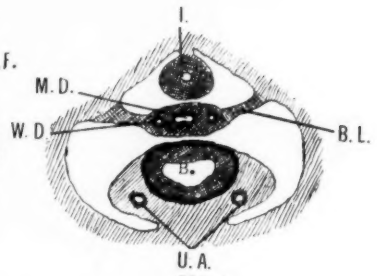

Fig. 5.

Fig. 3. Schematic cross section of embryo. *I.*, Intestine; *P.K.*, primordial kidney; *M.D.*, muellerian duct; *G. G.*, genital gland; *W.D.*, wolffian duct; *U.A.*, umbilical arteries. (After Corning.)

Fig. 4. Schematic cross section of embryo. *I.*, Intestine; *W.D.*, wolffian duct; *M.D.*, muellerian duct; *G.F.*, genital fold; *U.A.*, umbilical arteries. The urinary and genital ducts are gradually approaching each other, finally to unite as in Figure 5.

Fig. 5. Schematic cross section. *I.*, Intestines; *M.D.*, muellerian ducts in the broad ligament; *W.D.*, wolffian duct; *B.L.*, broad ligament; *U.A.*, umbilical arteries.

Robert Meyer wrote in 1897, that "cornual tumors arise from rests of the wolffian body, while all other forms of adenomyoma spring from the uterine mucosa." In 1903 he still championed the von Recklinghausen theory, and stated: "It is true that the normal tubal mucosa has no glands, but the pathological tube is different, it can produce them." In 1909 in the report of a case of adenomyoma of the pelvic colon, Robert Meyer propounded an additional histogenesis ascribing a hypoblastic origin, namely the intestinal mucosa. This view he withdrew later on in favor of the serosa theory and also declared the wolffian body theory to be "a myth that is dying very slowly."

Although Robert Meyer ascribed to the serosal epithelium a wide genetic latitude, he did not adopt it as the common source of all endometrial growths, as is implied in the following proviso: "After all the most prolific source of adenomatous growths is the uterine mucosa; but adenomata of the anterior vaginal wall, and of the rectovaginal septum arise from Gaertner's duct." In 1919 he relinquished the Gaertner duct theory, and extended the genetic sphere of the serosa to the adenomyomata of the rectovaginal and the rectocervical spaces.

Fourteen years have passed since Robert Meyer prognosticated the death of the mesonephric theory, and the end has not come as yet; on the contrary, it is being revived and rediscovered from time to time, and the serous epithelium theory has failed to take deep root.

In 1918 Lockyer was still adhering to the mesonephric teachings, and cited Wieger, who stated: "Since the round ligament sprang from the distal end of the kidney, passed the ovary as the true ovarian ligament to reach the uterine end of the tube, and from hence became the round ligament of the uterus; it could carry with it separated portions of the wolffian body, even to the distal parts, in the depths of the mons veneris. It was more difficult to understand how the round ligament could incorporate gland tissue from the uterine canal or from the muellerian ducts." He further criticized Kossmann for supporting the muellerian view as follows: "Kossmann's work stands out as an example of destructive criticism, but as a constructive effort it can not be said to have succeeded. In ramming von Recklinghausen's craft, he sank his own also." Lockyer's simile is metaphorically beautiful, but it could not save from sinking the leaky boat upon which the wolffian theory was embarked.

Cullen, the outstanding American authority on adenomyoma, began the study of this subject contemporaneously with von Recklinghausen, and from the very outset up to the present, he has maintained unswervingly, that all adenomyomata arise from muellerian rests, or from the uterine mucosa directly. He described his morphological findings thus: "The histological picture in a typical case of

adenomyoma of the uterus is very characteristic, the uterine mucosa is often of a normal thickness and looks perfectly natural, but as we approach the underlying diffuse myomatous tissue, the mucosa is seen to penetrate it in all directions, sometimes as an individual gland, but often large areas of mucosa are seen extending into the depth. In favorable sections, one can follow a prolongation of the mucosa half way through the uterine wall. Where the diffuse myomatous growth ends, the outward extension of the gland also ends. In the course of time, portions of the diffuse adenomyoma may project into the uterine cavity and be expelled through the cervix, as a submucous adenomyoma. In other instances a portion of the growth is forced to the outer or peritoneal surface forming a subperitoneal tumor. Such a myoma is prone to become cystic, and the cyst cavity or cavities will be filled with chocolate colored contents."

The above cited morphological picture is repeatedly reproduced in all of Cullen's prolific and meritorious studies made since 1896. In 1911, when commenting upon the histogenesis of adenomyoma of the umbilicus, he said: "In the early embryo Mueller's duct is not far removed from the umbilicus, if one has found uterine mucosa at the hilum of the ovary, in the round ligament, and in the inguinal region, I feel sure that some one will in the near future be able to explain to our satisfaction how the uterine glands reach the umbilicus."

It is thus evident that in spite of his painstaking studies and observations, Cullen could not arrive at a definite conclusion regarding the histogenesis. In his very latest contribution of 1920, he still asseverates that the origin of all adenomyomata is the muellerian or uterine epithelium; and leaves all incongruities, which characterized this theory from its very inception *in statu quo*.

Kossmann, in accepting the muellerian theory advanced the following reasons: "Every tissue that stands in structural relationship to the muellerian duct, either as an accessory thereof, or as a displaced group of uterine glands, must and does assume the same form, as soon as it comes under the influence of inflammatory or proliferative stimuli." Kossmann has thus sounded the first clear note in the histogenetic concept of adenomyoma.

Of the many other authorities who voiced the opinions of Cullen and Kossmann are Baldy and Longcope, Gottschalk, Klages, Lockstaedt, and Opitz. Additional citations would only mean futile reiteration, neither would the recital of more quotations from those who still uphold the mesonephric theory add in anyway to a better, clearer, or more definite understanding of the problem before us; hence we shall be content with the above review of the literature.

Recently, the study of ovarian adenomyomata has undergone a notable academic revival through the meritorious work of Sampson. This author, in attempting to fit in ovarian adenomata into the theoretic framework of displacement, postulated that these tumors are derived from the uterine mucosa which reached the ovarian surface through the fallopian tubes during menstruation. With all deference to Sampson's attainments, these teachings excel any of the previous histogenetic theories in pathological casuistry and phantasy. Why must we assume that under normal conditions, with a perfectly patent uterine and cervical canal, the menstrual discharge will reverse its course and flow upward, and force its way through the narrowest part of the tube in order to reach the ovary? His contention that the epithelium found in the tube lumen during menstruation is of endometrial origin, because it bears a close structural resemblance to the latter, is also not tenable; for we know now that structural identity alone does not signify genetic proof. In order to substantiate the above claim, it would be necessary to prove the absence of endometrial tissue in a previously ligated tube during menstruation; thus far no such experimental evidence has been furnished. We know also that the endosalpinx is capable of undergoing endometrial changes, as was frequently observed, in tubal pregnancy or in inflammatory or irritative conditions; so that the presence of such tissue in the tube lumen does not have to be of direct uterine origin. Furthermore, why must we believe

that the lifeless, desquamated epithelium, bathed in menstrual secretions, which are lytic in nature, as shown by O. Frankl; which are inimical to plant and flower life, as proven by Schick; and which contain various noxa, one of which, menotoxin, was recently isolated by Macht and Lubin; why must we believe that such epithelium, carried in this medium, is capable of becoming grafted. Stubler states that Sampson's claim for a retrograde flow of menstrual secretions in the presence of submucous polypi, myomata, and retroflexions, is thus far not proved. Furthermore, the epithelium that is desquamated during menstruation is no longer viable, and therefore it is incapable of taking root anew. In the face of these facts, it is difficult to accept the theory of Sampson as a dependable working hypothesis.

Synthesizing all these varied and contradictory theories and hypotheses, we come to the conclusion that all investigators considered displacement as an essential factor in the process of endometrial proliferation, but they did not agree upon the source of the displaced tissue. The advocates of the mesonephric and the muellerian theories had at least an embryological peg upon which to hang their histogenetic claims, and as long as the clinical observations were limited to the uterus and the fallopian tubes, these teachings could retain a seemingly scientific standdard. But when clinicians and pathologists began to report the occurrence of endometrial structures outside the anatomical course of the primitive genital and urinary tracts, then the deficiencies of the dogma of displacement became very apparent. This is the reason why the problem of histogenesis has as many answers as there are questions; in other words, no correct or definite answer.

Indeed what has prevented these keen observers from arriving at a unanimous opinion? Were their methods of investigation faulty? Is there really no common ground upon which those holding these views can meet? Is it possible to clear this path of research from the bleached bones of dead theories? This is the task undertaken in the present contribution.

RECENT EMBRYOLOGICAL AND BIOLOGICAL FACTS BEARING UPON THE HISTOGENESIS OF ADENOMYOMA

The method dominating every histogenetic and pathological inquiry is the "descriptive," which aims at an accurate recording of the form, shape, and size of the individual cells, and of the relationship they bear to each other and to the stroma as a whole. Its postulate is: morphological similarity proves genetic identity. This idea caused the adherents of the mesonephric theory to adopt a primordial kidney origin, because the arrangement of the glands in the adenomyoma seemed similar to those in the primitive organ; and those who by ocular observation discerned an endometrial formation concluded that the genetic source was the uterine lining. We cannot minimize the value of this method, but we must bear in mind that it constitutes only one of the means by which a conclusion regarding the histogenesis may be reached. To solve the structural origin of a tumor by morphological data only is as erroneous as to arrive at biological deductions from facts which are the result of cultural and environmental influences. In fact one of the weakest links in Darwinism is the overemphasis laid upon the purely formative side of evolution. We must also not forget that a fully formed cell such as we see in an adenomyoma or in other tumors is the product of genetic potentialities plus biological forces, which came into play in the latter stages of ontogeny. Histogenetic research must therefore antedate the period of cell differentiation.

Fischer stated: "When we examine a tissue or an organ we find that its chief components, the epithelium and the connective tissue, present well defined and differentiated structural characteristics. In the embryo, however, all epithelial cells, arising from all the three germinal layers appear alike; the same holds true of the embryonal connective tissue which consists essentially of the same cells throughout the body. Somehow, somewhere, at the proper time and moment, in the process of development, genetic forces harbored within the embryo, become liberated and distributed to the individual cell groups of the germinal layers, the latter respond to these

stimuli and begin to build up the tissues and organs they are destined to construct. What the forces leading to differentiation are, we do not know as yet. Biologists call them determinants, but we do know that for the unfolding of the genetic potentialities harbored within the cells, certain biochemical or physiochemical conditions must arise within the embryo." We may hence assume justly that normal and abnormal growth are respectively the results of a balanced or a disproportionate play, between the stimulating and the inhibitory genetic forces. We also know that the multipotency of the epithelium of the germinal layers is only partly used in the upbuilding of the body. The rest or excess of the epithelial cells remains permanently or temporarily quiescent, depending upon whether the genetic forces remain potential or become kinetic. Besides the growth influences furnished by the embryo, and the growth requisites supplied by the cells, there is also an intercellular factor, which strikingly affects the process of differentiation; namely the structural and functional relationship between the covering epithelium and the underlying connective tissue.

Upon the biological phases of intercellular reciprocity, Fischer expressed himself as follows: "We may postulate it as a law in organic development, that the epithelial elements play the dominant and leading rôle, the connective tissue the subordinate or dependent part. The former becomes differentiated in a definite manner in the early stages of development into typical types for each organ; the connective tissue portion on the other hand differentiates itself much later, and the manner of its differentiation is dependent upon the formative influences which the overlying epithelium exerts upon it. The connective-tissue dependence upon the epithelium continues throughout life; during the embryonal state the dependence is formative, and later on functional."

Another very pertinent biological fact in the study of histogenesis is the constant reciprocal relationship between genetic potentialities and genetic forces. We have stated before that the primitive epithelium is multipotent so that it can form any type of epithelium, but this property is enjoyed by it only up to the time of segregation when this apparently homogeneous mass of epithelial cells subdivides itself into definite cell groups, each of which is destined to form a specific tissue or organ. The moment this division has taken place, then the genetic potentialities inherent in, and characteristic of, each cell group, unfold themselves, and remain invariable properties of these cells throughout their entire existence. Furthermore, these genetic potentialities respond structurally and functionally only to their own and peculiar genetic forces furnished by the embryo as a whole. Through the harmonious play between the intrinsic and the extrinsic cellular forces normal growth develops and function progresses.

Hence a conclusion regarding the histogenesis must be so comprehensive as to include not only proof of structural identities between the neoplasm and the tissue or organ of which it is claimed to be a derivative, but also evidences of functional similarity.

THE MODERN CONCEPT OF THE HISTOGENESIS OF ADENOMYOMA

Although unable to explain satisfactorily how the muellerian rests have reached many of the adenomyomatous sites, Cullen and his school, were nevertheless right in their steadfast adherence to their theory, for they have always observed that the adenoid growths in the tumors bore not only a structural resemblance to the endometrium, but that they also simulated the uterine mucosa functionally. The followers of the mesonephric theory could claim at best only formative resemblances, but at no time were they able to prove functional processes in the adenomatous tumors which equaled those of the fully developed kidney. One of Robert Meyer's very latest statements, that "the ovarian hormones may also influence primordial kidney rests to endometrial proliferation" must be accepted very guardedly and dubiously. This supposition is most likely founded upon the multipotency and structural homogeneity of the cœlomic epithelium out of which both the genital and the urinary organs are derived. This is, however, not a valid reason for the

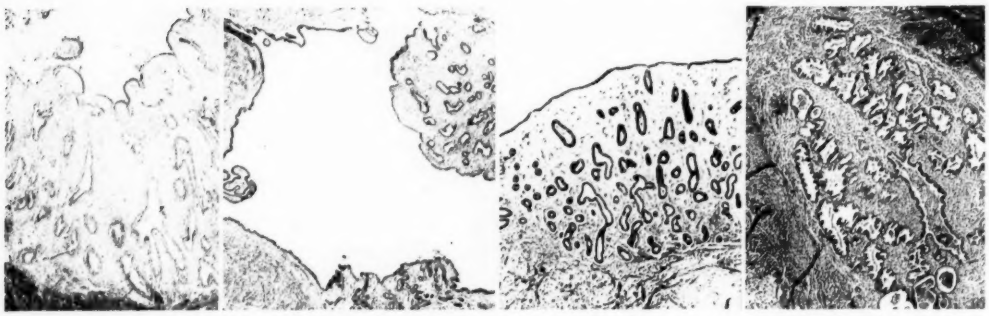

Fig. 6. Fig. 7. Fig. 8. Fig. 9.

Fig. 6. Adenomyoma of ovary, postmenstrual phase.
Fig. 7. Adenomyoma of ovary, interval.
Fig. 8. Adenomyoma of ovary, beginning secretory stage.
Fig. 9. Adenomyoma of ovary, menstruation.
(From Aschheim.)

admission of promiscuity between genetic potentialities and genetic forces.

The fact that we cannot as yet distinguish by the means at our command between the very earliest anlagen of the apparently uniform cœlomic epithelium, does not warrant the assumption that cells destined to form genital organs can and will respond to stimuli prepared for the activation of urinary rudiments, and vice versa. According to Corning, "We are still unable, with the means at our disposal, to detect sex differentiations before the embryo has reached the length of 18 to 20 millimeters; this does not imply, however, that no sex differences exist before this time, and we have no right to call this period the indifferent state. On the contrary, it is becoming more probable that sex determination develops early in the ovular period."

What is true of sex determination is and must be equally true of genetic potentialities which are present in the cell long before microscopy can reveal them, and of the genetic forces, the mutual action and reaction of which are subject to well defined and invariable natural laws. The clinical and microscopical evidences furnished by the study of adenomyomatous tumors bear undeniable testimony to the scientific claims embodied in the above biological axioms. Lauche has correlated these scientific truths to the clinical facts in his latest monumental contribution, the basic principles of which are the following: (1) Adenomyoma is a neoplasm peculiar to the female. (2) The epithelium lining the glands responds formatively and functionally to the ovarian hormones in the same manner as does the endometrium. (3) This reaction occurs in the tumor and in the uterine mucosa simultaneously. (4) The hormonic response is greatest during the height of sexual activity.

I shall now demonstrate these facts by a series of photomicrographs of an ovarian adenomyoma. In Figures 6, 7, 8 and 9 are represented respectively the postmenstrual, the interval, the beginning secretory, and the menstrual phases; and were it not for the fact that ovarian stroma surrounds these gland spaces, no pathologist could differentiate these morphological changes from those taking place in the endometrium proper. To be true to the biological axiom that genetic evidence rests upon functional as well as upon structural similitude, a section of ovarian adenomyoma in the postmenstrual phase was stained for glycogen, and the glycogen appeared bright red, exactly as it would have looked in a section taken from the endometrium itself (Fig. 10). Of the other morphological changes which take place in the heterotopic endometrial structures is a decidual reaction. Williams and others have observed it in gravid adenomyomatous uteri; I have observed decidual reactions in the tubal mucosa in cases of intra-uterine and extra-uterine gestation, as well as decidual reactions of the serosa of the appendix. The pertinent facts adduced from this demonstration prove that there is a structural and a functional identity between heterotopic endometrial prolifera-

tions in the ovary and the uterine mucosa; hence both must have a common genetic source, and must be influenced by the same hormone or hormones. The same applies to all types of adenomyoma.

What is this common genetic soil from which spring all endometrial growths? Since the cœlomic epithelium is the structural source of the generative organs, any morphological phenomenon arising within the body during adult life which simulates the uterus structurally and functionally must of necessity be a derivative of the same embryological rudiment. What really takes place in the evolution of an extra-uterine endometrial growth is a topical awakening of the genetic potentialities in some of the unused cœlomic rests; through a sudden increase of the stimulating, or through a diminution of the inhibitory genetic forces. With this explanation, the difficulties presented by the theory of displacement are at once removed; and since it is not necessary for endometrial or endosalpingial parts to be actually transported to different regions in the body, to act so to speak, as adenomyomatous seeds, the terminology of displacement must be discarded. In its stead, Robert Meyer proposed the terms, heterology, or heteroplasia of the peritoneal epithelium. The same process of reasoning is applicable to the cytogenous tissue present in the adenomatous tumors, which was considered by the adherents of the theory of displacement as positive proof of endometrial transportation, since this tissue is not found anywhere else in the body except in the uterus; this however, is not the true condition. If we recollect the biological principle that the overlying epithelium exerts a definite formative and functional influence upon the supporting connective tissue stroma, then the finding of cytogenous tissue around the glandular spaces is but a normal and natural sequence. And just as the cœlomic epithelium is capable of heterotopic endometrial proliferation without having to be displaced from the primitive (or fully developed) urinary or genital tracts, so can and does the connective tissue in the vicinity of these glands undergo cytogenous metamorphosis identical with that of the uterus without the process of displacement.

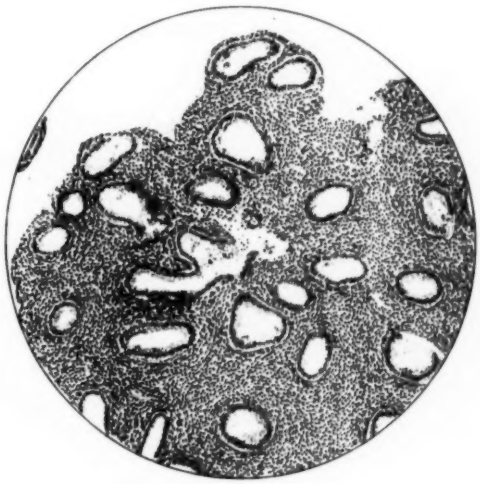

Fig. 10. Adenomyoma of ovary; postmenstrual phase; glycogen deposits (Aschheim).

The following demonstration elucidates these facts very succinctly.

In Figures 11, 12, 13, and 14 are reproduced respectively sections of adenomyomata from the intestinal wall, the round ligament, the umbilicus, and a laparotomy scar; and each shows that wherever the lining epithelium is high and columnar, i.e. active, its underlying connective tissue also bespeaks function, as evidenced by the increase in the number and size of its cells. On the other hand, those portions of the gland circumference, bearing a low cuboidal epithelium, present a correspondingly inactive connective tissue. These photomicrographs also emphasize once more the illusiveness of morphological facts alone, as criteria for histogenetic conclusions. How could the propounders of the older histogenetic theories claim different genetic sources for the differently located adenomyomata from their histological studies only when there are no structural differences between the various adenomyomatous growths. Were it not for the fact that the sources from which these different sections were obtained are known, no pathologist could tell from a microscopic examination their organic derivation. The heterotopic character of adenomyomata in no way militates against their homogeneous

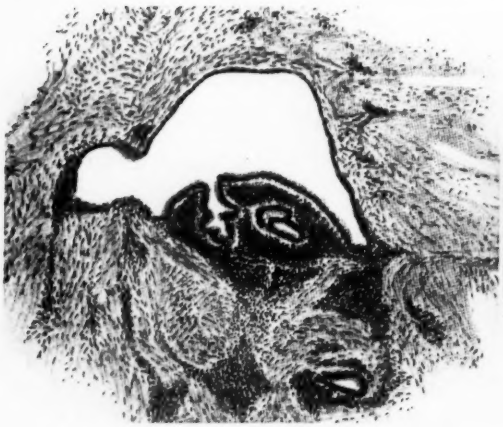

Fig. 11. Adenomyoma of intestinal wall (Lauche).

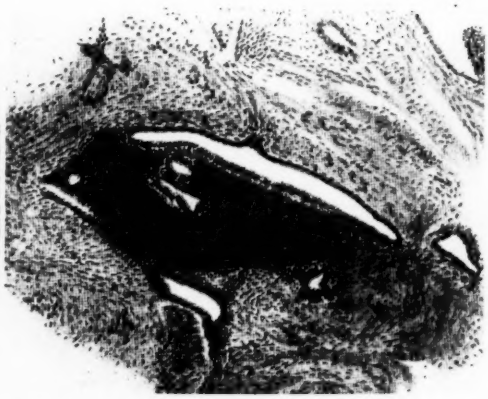

Fig. 12. Adenomyoma of round ligament (Lauche).

morphology and functional responses to proper and specific activators; hence all adenomyomata have the same genetic soil.

THE CLINICAL VERIFICATION OF THE BIOLOGICAL AND EMBRYOLOGICAL PRINCIPLES

The keystone of the histogenetic arch is the structural and functional similarity between the neoplasm and the soil of its derivation. Of all the tissues in the female organism, the cœlomic epithelium is unique in possessing adenomyomatous anlagen. To complete our histogenetic equation, we must add to the already known factors, genetic potentialities and genetic forces, the anatomic proof that cœlomic epithelium or its later modifications into peritoneum or mucosa is present in the locations indicated in Figure 15, as the adenomyomatous centers.

Uterine and tubal adenomyomata, in which the anatomic continuity between the endometrium or the endosalpinx and the neoplasm is traceable, present no histogenetic problem. The adenomyomata occupying the outer uterine zones or situated subperitoneally are derived from the covering serosa; a definite adenomatous source.

Ovarian endometrial growths arise from the covering germinal epithelium; and while this tissue also serves as a genetic source for other tumors, it manifests the adenomyomatous proclivity under certain and propitious conditions only. Inflammation may at times act as an exciting cause. At times the adenomyoma of the ovary may be a prolongation from a similar growth in the uterine wall. Whichever may be the case, the cœlomic epithelium is basically the starting point.

Round ligament adenomyomata, whether of the intra- or extra-abdominal portions, take their origin from the peritoneal reflection, which accompanies it throughout its course, at times even as far as the labia majora.

Umbilical adenomyomata also originate from cœlomic rests, the exocœlom, which accompanies the urachus, the allantois, and the umbilical blood vessels, as they make their exit through the umbilical ring.

Laparotomy scar adenomyomata may develop after operation in which the genitals did not enter into the operative scope; this fact has been proved clinically. The genetic source is the injured parietal peritoneum.

All the other organs and tissues in which adenomyomata have developed, have as one of their anatomic constituents either a serous covering or a lining which in the broad embryological sense is the same; hence a potential adenomyomatous source.

We have now carried our histogenetic concept to its final, logical, and scientific conclusion. We have proved that all adenomyomata are alike in structure and function, that they all respond to the same stimulating or inhibitory somatic forces, and that they all

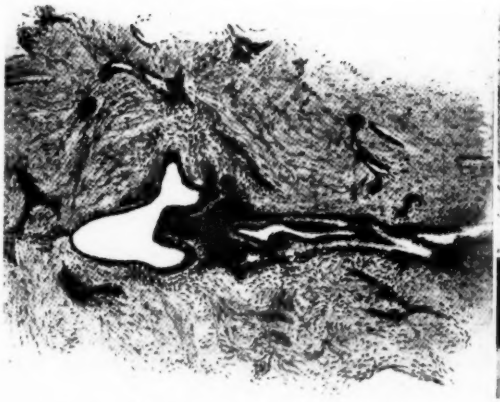

Fig. 13. Adenomyoma of umbilicus (Lauche).

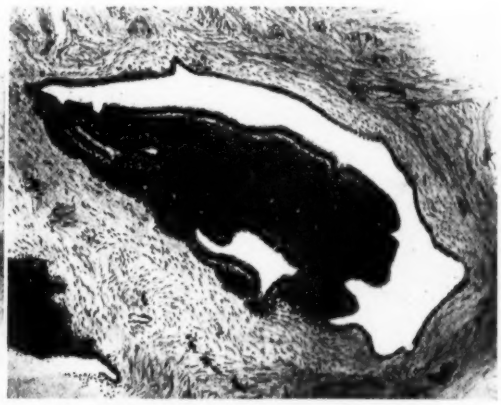

Fig. 14. Adenomyoma in a laparotomy scar (Lauche).

possess cœlomic rudiments, hence the basis for a heterotopic endometrial proliferation. We may now proceed to the next question, and ask what is the cause of adenomyoma?

ETIOLOGY

For the tubal adenomyomata Chiari accepted an inflammatory cause. In my study of "the pathogenesis of adenomyosalpingitis" published in 1913, I have arrived at a similar conclusion. The bases for the inflammatory theory were (a) the associated subacute or chronic salpingitis of a neisserian or tuberculous nature; and (b) the seemingly identical intratubal and intraglandular contents. Robert Meyer and von Franque also laid stress upon inflammation as the etiological factor in the development of pelvic adenomyomata. In the causation of Sampson's cases we also find clinical data pointing to associated pelvic inflammation. These were the reasons why Robert Meyer and also von Franque questioned whether adenomyomata should be included in the category of tumors. They were of the opinion that these neoplasia were mixed tumors consisting of myomata with inclusions of hyperplastically inflamed glands, hence the term "adenomyositis." In support of this view, the above quoted authorities cited the clinical observation that these tumors diminish in size or disappear at times with the subsidence of the inflammation.

Notwithstanding these opinions and observations, it is my conviction that while inflammation may act as the primary impulse in some cases, and sets the cœlomic rests into the proliferative swing, it is not the final cause dominating the further development of these tumors.

No matter how inflammation may be defined, the three cardinal phases postulated by Lubarsch: alteration, exudation-infiltration, and proliferation will always constitute the triad characterizing a tissue response to microbic or foreign invasion. At least two of these phases must be present in a tissue reaction before we may term it inflammation. Are these reactions present in the adenomyomatous growth *per se?*

After examining many sections of adenomyomatous tissue, and also some of those designated as adenomyositis I could not discern the true inflammatory changes. The most prominent morphological phase in these tumors is the proliferative, associated at times with a lymphocytic infiltration, but no leucocytosis, no cell destruction, and no reparative replacement by connective tissue. In looking backward upon the criteria which were accepted as indicating that adenomyosalpingitis was a direct inflammatory product, I am constrained to state that those views must now be changed. The adenomyomata in the tubal wall as such, did not show definite inflammatory reactions. Regarding the intraglandular contents which resembled so closely those of the uterine cavity or of the tube proper, and were therefore accepted as

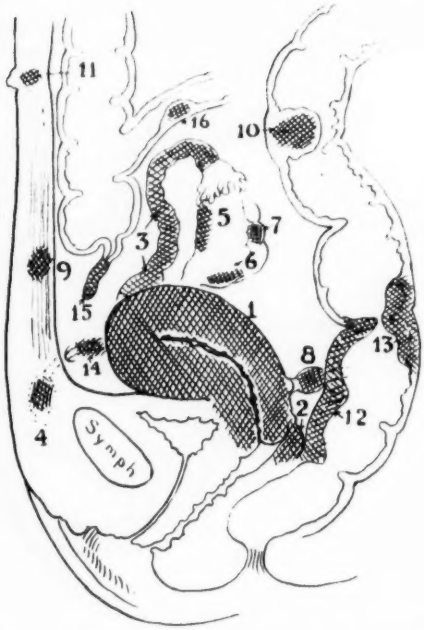

Fig. 15. Schematic drawing showing the sites at which adenomyomata were found: *1*, uterus; *2*, rectovaginal septum; *3*, fallopian tube; *4*, inguinal part of round ligament; *5*, *6*, *7*, hilum and cortices of ovary, and utero-ovarian ligament; *8*, sacro-uterine ligament; *9*, rectus muscle; *10*, sigmoid; *11*, umbilicus; *12* and *13*, anterior and posterior rectal walls; *14*, intraperitoneal portion of round ligament; *15*, appendix; *16*, ileum. (After Cullen and Lauche.)

evidence of a direct transportation of tubal mucosa into the depth of the tube wall, we can now interpret these phenomena as simultaneous biological processes. Furthermore, if we analyze carefully the intratubal contents in adenomyosalpingitis, in uterine adenomyomata, or in ovarian adenomyomata, we will find pigment, red blood cells, proliferation and desquamation of the columnar epithelium, and various degrees of round cell infiltration. In what way may I ask, do these morphological changes differ from those observed in the premenstrual or pregravid endometrium? Aschoff's subdivision of inflammation into defensive and protective types may serve our purpose very well. The reaction taking place in the endometrium of a gravid uterus may be considered as protective, for the impregnated ovum while the result of a biological process, is nevertheless a foreign body to the female organism as a whole. The adenomyomatous tumors, by their alteration in size, premenstrually and postmenstrually, and by the microscopical and biochemical changes noted within them during the different phases of the menstrual cycle and during gravidity, speak loudly for biological metamorphosis rather than for inflammatory processes. In view of these facts, we have to consider bacterial inflammation as a possible initiative but not as the ultimate cause of endometrial proliferation. The cause of adenomyomatous growth is an excess of ovarian hormones which under given biological conditions exert a proliferative influence upon the dormant cœlomic rests to adenoid formations; the latter respond to this hormone in a functional way as well, as expressed clinically by menorrhagias and metrorrhagias, by the formation of tarry cysts in the ovaries, and by the periodic enlargements and shrinkage of the adenomata at the beginning and at the end of each menstrual period.

CONCLUSIONS

1. Histogenetic investigation must antedate the period of cell differentiation.
2. Morphological similarity is not synonymous with histogenetic identity.
3. Histogenetic proof demands functional as well as structural similarity between the neoplasm and the tissue or the organ of which it is claimed to be a derivative.
4. The theory of displacement no longer fulfills our present concept of heterotopic endometrial formations; it should be discarded.
5. Adenomyoma is peculiar to the female and is prevalent during the period of maximum procreative function.
6. The cœlomic epithelium harbors adenomyomatous potentialities, which it unfolds when acted upon at the proper time and moment, by specific genetic forces furnished by the body as a whole.
7. The columnar epithelium is capable of exerting cytogenic influences upon its supporting connective tissue.
8. The genetic source of all adenomyomata irrespective of location, is the cœlomic epithelium.

9. Inflammation may precipitate an adenomyomatous process but it cannot enhance its growth and development, the latter being the result of biological or biochemical processes.

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HÆMANGIOMATA OF THE BLADDER AND URETER

By JOHN ROBERTS CAULK, M.D., F.A.C.S., St. Louis, Missouri

TUMORS of vascular origin of the bladder and ureters are so rare that the following cases seem worthy of report. The first case was a telangiectatic hæmangioma of the bladder wall; the other, a pulsating cavernous hæmangioma of the ureter simulating inoperable carcinoma of the bladder. I group these two cases, since the angioma of the ureter made its impression beneath the mucous membrane of the bladder in two places eroding it with the production of hæmorrhage, so that at first it gave every appearance of a vesical growth.

Case 1. Male, age 35, consulted me in April, 1918, complaining of the passage of blood in urine. The past history is entirely negative, except that he had gonorrhœa as a young man, but no history of lues. There had been no history of birth defects in his family and he had never been seriously ill. Patient has been perfectly healthy until 6 weeks before admission, when, without premonition, he began passing blood in the urine. He described the blood as being entirely mixed with the urine and having the appearance of dark wine. The bleeding had been constant during this period, but on several occasions had been less profuse. There had been absolutely no other urinary disturbances; no history of pain in kidney regions, nor any reflected pains in back or legs. Sexual powers were normal. He had not lost weight, but patient felt he was a little weak from loss of blood.

Examination revealed a healthy looking man, somewhat pale. General examination was entirely negative. No abdominal masses were present. The external genitalia were normal. The urine passed in 2 glasses, was dark brown in each. Microscopically it contained blood, but no infection was found. Rectal examination showed the sphincter tone good. The prostate was normal in every way. On making a cystoscopic examination the cystoscope entered easily. The bladder was easily washed clean. On casual inspection, it seemed to be entirely normal. The ureteral orifices were normal, and clear urine was seen coming from each. After a careful search there was observed on the left lateral wall of the bladder approaching the sphincter margin a very small spider-web dilatation of blood vessels, in the center of which was a pinpoint bluish elevation, from which was issuing a constant fine stream of blood. The bladder wall in the vicinity of this growth was entirely normal. The tumor had the appearance of an ordinary nævus. Diagnosis: Hæmangioma.

Treatment. The tumor was burned with high-frequency current and completely destroyed. Patient was cystoscoped a week later and at the site of burning there was a small ulcer. At the end of a month the ulcer had entirely healed, leaving no evidence of the previous tumor. Patient has remained well.

Case 2. Woman, age 60, consulted me in October, 1923, complaining of passage of blood in the urine. The past history is entirely negative, except for an attack of bleeding. Five years ago patient passed a little blood at the end of urination. This lasted for one or two voidings, subsided, and did not recur until 2 weeks ago. In the meantime there has been absolutely nothing to concern her. Two weeks ago, without cause, she began passing blood in the urine. Blood has been bright and usually appears at the end of urination. The urine has never been dark and she has never passed clots; no frequency, difficulty of, or pain on, urination; no pains in back, legs, or history of renal colic; no fever, chills, or loss of weight, but she has been very nervous. The day before I saw her she had consulted a gynecologist, who found, upon making a vaginal examination, that there was a very hard, indurated area on the vault of the vagina corresponding to the base of the bladder in the region of the trigone, situated a little to the right of the median line. This mass was about 1 inch to 1¼ inches in length and about ¾ of an inch in breadth. The same physician had sent me a patient a year previously with, as he said, the identical palpable findings and the mass proved to be due to an infiltrating squamous celled carcinoma of the bladder wall.

Examination revealed a stout, healthy looking woman. The general examination was entirely negative. Upon vaginal examination, I felt an indurated mass which was exactly similar to that in the case above alluded to which proved to be cancer. The mass was very hard, very fixed, but not sensitive.

Cystoscopic examination showed the bladder capacity normal. The urine was slightly tinged with blood. Upon examining the bladder, there was observed a peculiar condition of the left lateral wall and base starting from the left ureteral orifice and running outward and upward. The bladder wall gave the appearance of rigidity. The mucous membrane was quite smooth over this area, which had a peculiar mottled appearance consisting of areas of blue and almost black spots intermingled with lighter cystic looking masses, between which there were slight corrugations. This area seemed about 1 inch in length and about ¾ inch in diameter and corresponded exactly to the size of the vaginal induration. At the outer edge of this mass there was a

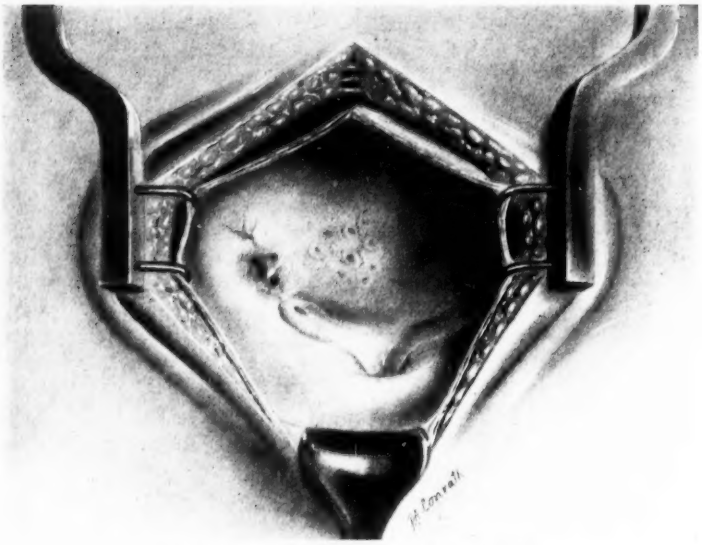

Fig. 1. Appearance of angioma of the bladder.

typical telangiectatic spider-web dilatation of vessels. In the center of this thickened area there were two spots with adherent small blood clots. The striking feature of this whole area was its pronounced pulsation. There was no projectile growth in the bladder cavity. Catheters were passed up the ureters and they were both perfectly free and the urine from the kidneys was clear. With the finger in the vagina, pressure on this indurated area elevated the bladder growth. No pulsation could be felt through the vagina.

My associate, Dr. Sanford, and I were both struck with the marked pulsation of the tumor, and this coupled with the telangiectatic area at the upper part made us feel that the tumor was very vascular and most probably a hæmangioma, but because of the rigid appearance of the bladder wall, the infiltration of the vaginal vault and associated hæmaturia, carcinoma of the bladder with extension seemed inevitable.

On November 30, 1923, I did a suprapubic cystotomy. Upon freeing the right side of the bladder down to the vault of the vagina, I felt a very hard, stonelike mass binding the bladder and the vaginal vault together. After exposing this mass, I was able to dissect it out quite nicely, and it proved to be a large calcified lymph gland plastering these two structures together. It was located at the juxtavesical ureter. After removing the gland, the vaginal vault felt perfectly soft. Bladder was opened freely and the area which had been observed cystoscopically was seen. There was no hardness, the mucous membrane was perfectly smooth. With the palpating fingers on the outer side of the bladder and the thumb within its cavity, there was felt between them an elliptical mass about the size of a large pecan, quite movable and having a rubbery feel. Upon delicate pressure it could be felt to pulsate. The posterior wall was opened with an incision running from the tip of the trigone upward and outward external to the outer margin of this mottled area of mucous membrane. Upon incising the mucous membrane, a mass which was quite irregular, firm, and elastic presented itself. It was easily separated from the mucous membrane of the bladder, which it had partially eroded in one spot, this being the spot to which the blood clot was adherent upon previous cystoscopic examination. On further study, it was found that the growth had completely encircled the ureter, which was exposed for at least 2 inches from its juncture to the bladder. The mass was quite encapsulated, and under the surrounding fascia could be seen the irregular conglomerate masses of vascular dilatations. The tumor was incised on its anterior surface about the ureter until the wall of the ureter was exposed, grasped on either side with clamps, and completely freed from the wall of the ureter. It was adherent in several places to the adventitia. The chief attachment was at the lower part, as the ureter entered the mucous membrane of the bladder. Here there was a vessel the size of a small match, which was ligated and the tumor removed entire, leaving the ureter intact. It had not constricted the ureter or produced any evidence of obstruction. After the removal of the growth there was no evidence of palpable mass in the bladder wall. The mucous membrane over this growth was resected, the posterior wall of the bladder

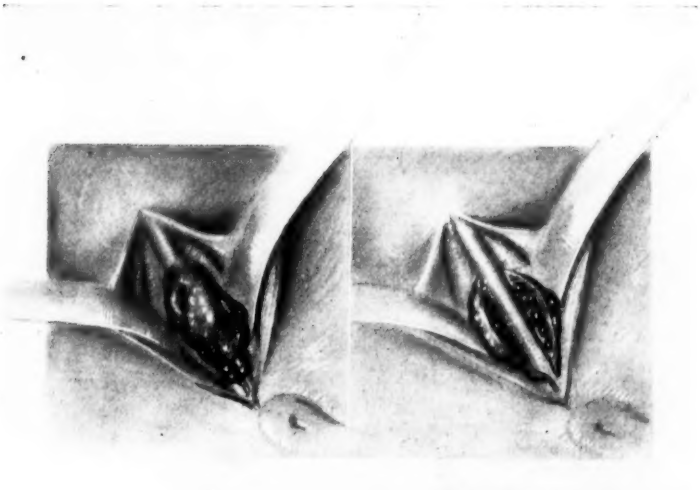

Fig. 2. *a* (Left), Angioma surrounding ureter, posterior wall of bladder opened; *b*, angioma incised in front of ureter.

was sutured, the bladder closed as usual around a tube drainage, a cigarette drain was placed in the space of Retzius and another in the lateral cavity in the neighborhood of the ureteral portion.

Patient made satisfactory recovery and is entirely well. Cystoscopic examination 3½ months after operation shows no sign of bladder wall involvement, bladder being entirely healed and normal in appearance.

Pathological examination showed the tumor to be rather firm and opened out, as it was between two clamps, and it measured about 1¼ inches in length and about 1 inch in width and ½ inch in thickness. On section it was seen to be composed of large dilated spaces filled with blood clots, between which there was a definite mass of fibrous tissue. Some of the spaces were quite large. Microscopically the tumor seemed sharply circumscribed, composed of large irregular spaces filled with blood, lined with endothelium, between which there was a fibrous tissue stroma and numerous smooth muscle fibers. One artery of considerable size is seen in cross section. It shows extensive calcification and thickening of its walls, a pronounced senile arteriosclerosis. A small portion of the bladder wall which was removed with the tumor is normal, except that it shows extravasation of blood between the muscle bundles. There are several areas of pigment deposit, apparently the result of previous extravasation. Pathological diagnosis: Characteristic hæmangioma of the cavernous type.

Hæmangiomata of the bladder are extremely rare. The first observation of such a tumor in the bladder was by Gross in *Treatise of the Urinary Organs*, 1851. The patient was a woman, 72 years of age, who suffered from hæmaturia. A soft irregular cauliflower tumor was found at autopsy, but no histological description was given.

The first authentic tumor of this type was described by Albarran in 1892 in a man 64 years old, who had suffered from hæmaturia. He died at operation performed by Guyon. Microscopic examination showed capillary dilatation surrounded by connective tissue. The tumor was submucosal and bladder epithelium was well preserved.

In 1909, Robert Bryan of Richmond reported a typical cavernous angioma which he removed by suprapubic cystotomy. At this time he remarked that he had been able to find no reference to such a growth in the bladder, except by Albarran, *Tumeurs de la vessie*, Paris, 1891; Langhans, in Virchow's *Archiv*, 1879, lxxv, 291.

Judd and Harrington in "Tumors of the Urinary Bladder,"[1] report a case of large polypoid tumor filling a greatly hypertrophied bladder extending through the bladder wall into the right extravesical space, with a growth as large as a grapefruit.

[1] South. M. J., 1918, x, 129.

Launay, Achard, and Carriere,[1] reported a large angioma the size of an orange removed from the posterior and right lateral wall of the bladder by partial cystectomy from a patient who had complained of frequent, painful urination with hæmaturia and pain in the right iliac fossa. Diagnosis was appendicitis and the operation was performed for this condition. The tumor was composed of large dilated blood spaces filled with clots surrounded by connective tissue.

Thomas described a small angioma of the bladder cured by fulguration which was similar to my first case above described. Lane reports a cavernous angioma of enormous size in a child 3 years of age. Jungano observed a massive cauliflower angioma of the trigone undergoing sarcomatous degeneration. The most recent report of this rare bladder condition is by Frank Kidd[2] of London. He reports a polypoid pedunculated tumor attached to the anterior wall of the internal meatus projecting into the bladder in a patient who had suffered from acute retention of urine with severe cystitis, but only slight hæmaturia, which followed catheterization in one or two instances. The tumor he described as looking like a raspberry, was removed by suprapubic cystotomy and was found to be composed of a central core of muscle similar to that of the bladder covered by bladder epithelium. This central core of the muscle contained large and numerous blood vessels, which on section proved to be angiomatous. He designated his tumor as angiomyoma.

Scholl[3] speaks of the rarity of angiomata of the bladder. These tumors may be small and have as their only symptom a persistent profuse hæmaturia; or they may be extensive and penetrate into the prevesical tissues simulating growths of other pelvic organs. Watson found but two angiomata in 653 collected tumors. It is, therefore, evident that hæmangiomata of the bladder are very rare tumors which have as their usual symptom hæmaturia, which has a tendency to be constant and, unless the tumor involves the bladder outlet or attains an enormous size, hæmaturia may be the only symptom.

After a careful search through the literature, I have been unable to find a single report of a hæmangioma of the ureter. It seems, therefore, that my second case is unique. The striking feature of the tumor in this case was its pulsation. I have seen no mention of pulsation in any of the other tumors. The pulsation in this tumor was indeed pronounced. It would seem from the structure of these growths that such a finding should be common, but it depends, of course, on the relation to the artery. The explanation of the terminal bleeding in this tumor is that, at the expulsive effort at the end of urination, the bladder contracted against the vascular mass between its walls and the mucous membrane had thus begun to be eroded. The case is of great clinical interest, because it so simulated an infiltrating cancer of the bladder wall.

[1] J. d'urol. méd. et chir., 1920, IX, 385.
[2] Surg., Gynec. & Obst., 1923, XXXVI, 467.
[3] Surg., Gynec. & Obst., 1922, XXXIV, 139.

POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG[1]

By GEORGE HALPERIN, M.D., Chicago
Assistant Surgeon, Wesley Memorial Hospital

A CRITICAL study of the literature on the subject of postoperative pulmonary complications discloses the fact that their incidence has not diminished. Statistical studies of Norris, Pepper, McKesson, Cutler, and Hunt place the incidence of morbidity caused by pulmonary postoperative complications at from 2 to 4 per cent and the mortality from the same cause at about 0.6 per cent. This incidence has not been decreased by the use of local anæsthesia.

One is also impressed with the radical change in our conception regarding the nature of these lesions, and their mode of production. Such terms as aspiration pneumonia or ether pneumonia have been to a great extent discredited. The newer conception teaches that all postoperative lung lesions are caused by the transfer of small particles either sterile or infected from the field of operation to the lung tissue. In other words, we are here dealing with embolisms and infarctions.

Among these well known and well understood complications the so-called massive collapse of the lung is a new, or at any rate judged by the scarcity of the reported cases, a rare condition.

Its recognition nevertheless is a matter of considerable importance to the patient both from the therapeutic and prognostic viewpoints. The physical and roentgenological signs of this condition are so striking and so characteristic as to make its recognition relatively easy provided the examiner is familiar with the picture.

It is not my intention to review the literature since this has already been done by others, notably by W. Lee (1). I shall be content here to sketch briefly the development of our knowledge of the subject.

William Pasteur (2), an English physician, first recognized and described in 1890 what he had termed massive collapse of the lung.

His first observations dealt with cases of postdiphtheritic paralysis. He diagnosed the condition in 34 patients, and had the opportunity to verify the diagnosis in several cases which came to postmortem. Applying his knowledge thus gained to the study of postoperative material at the Middlesex Hospital, Pasteur found 12 cases of massive collapse of the lung out of a total of 201 lung complications.

Important contributions to the subject were made by Sir John Rose-Bradford (3) during the late war. He had seen this condition most frequently as a complication in injuries to the chest. It sometimes followed most trivial non-penetrating wounds of the thorax, also of the buttocks, the pelvis, or the thigh. He made the interesting observation that not infrequently the collapse took place on the uninjured side of the chest, a condition which he called contralateral collapse. He believes with Pasteur that the *modus operandi* of this condition is a reflex nervous phenomenon.

In civil practice the condition is seen most often after abdominal operations. The time of onset may be as early as a few hours or as late as 7 days. It may be ushered in suddenly and may suggest a catastrophe of a serious nature, such as a coronary embolism, huge pulmonary infarction, or acute dilatation of the heart. Far more commonly, however, the onset is rather insidious. There is noted a moderate rise in temperature, the pulse is only moderately accelerated, the respirations are seldom above 30. The patient exhibits but a mild degree of discomfort and the dyspnœa is not at all marked. There is very little cough, the patient frequently complaining of his inability to "cough it up." A very small amount of mucopurulent stuff is brought up with great difficulty.

The physical signs are most characteristic. I feel that I could do no better than to quote verbatim from the classical description of Rose-Bradford. "The cardiac impulse is greatly displaced toward the affected side, the

[1] Read before the Chicago Surgical Society, March 6, 1925.

displacement is lateral and upward, the lateral displacement being usually far the greater. If the left be the affected side, the apex beat may be found in the axilla, if the right the impulse may be felt in the right nipple line. There is often marked displacement of the impulse upward, and it may be palpable as high as the third rib. The affected side of the chest is retracted and immobile, and the ribs can be seen and also felt to be closer together than on the normal side. The high level of the diaphragm can be readily demonstrated on the left side by percussion; this method is not so satisfactory on the right side, but X-ray observation not only demonstrates the high level of the diaphragm but also reveals its immobility on the affected side. The percussion note is impaired all over the affected side, and dulness, marked in amount, may be present up to the level of the clavicle. In the left axilla, because of the altered position of the diaphragm resonance to an abnormally high level is present. Tactile vocal fremitus is either diminished, absent, or increased. If diminished or absent, the breath sounds are also diminished or absent; if increased the breath sounds are tubular or amphoric in character. In such cases bronchophony and pectoriloquy are exceedingly well marked. Thus, two groups of cases may be recognized: one with diminished or absent tactile fremitus and breath sounds, and one with increased tactile fremitus, together with tubular or amphoric breathing and with bronchophony and pectoriloquy. The difference depends upon the relative patency of the bronchial tubes. In both cases extreme displacement of the heart is present.

"The physical signs may be summarized by saying that the pulmonary signs present a considerable resemblance to the well known signs of consolidation; if anything they are rather more marked, especially in the tubular or amphoric character of the breath sounds; these signs are, however, accompanied with retraction and immobility of the chest wall together with displacement of the heart and of the dome of the diaphragm. These characteristic signs sharply differentiate cases of massive collapse from other pulmonary lesions and from pleural lesions."

Several theories have been brought forward to explain the mechanism of the collapse. Pasteur and Bradford incline to the neurogenic origin. Pasteur's postdiphtheritic cases undoubtedly were examples of paralysis of the diaphragm due to the lesion of the phrenic nerve. Bradford's cases of contralateral massive collapse certainly strongly point to a reflex nervous mechanism.

A number of observers believe that bronchial obstruction is the essential factor. Assuming that in postoperative cases there is a limitation of pulmonary expansion and retraction, one can readily see that mucus is formed and is not expelled, causes an obstacle to the ingress of air into the smaller bronchioles, and leads to ultimate alveolar absorption of the air into the circulation. The only experimental work offered in support of this theory is that done by Lichtheim in 1878. He introduced laminaria plugs into the bronchi of rabbits. Collapse of the lung tributary to the bronchus took place. The theory of bronchial obstruction fails to explain the cases of contralateral collapse; as Sir Bradford remarks there must be other factors operating the nature of which is not recognized.

Prognosis of this condition is very good, very few fatal cases were reported. The lung becomes completely reinflated in about 10 days. Occasionally reinflation is delayed for 3 or 4 weeks. On the other hand, restitution sometimes takes place in a surprisingly short time.

CASE REPORT

Mr. J. P., admitted to the private service of Dr. H. M. Richter, at the Wesley Memorial Hospital, November 3, 1924. The patient was a male, 33 years old, very muscular, and apparently in vigorous health. His case had been studied prior to his entry by several competent internists, and X-ray examinations had been made on two separate occasions. Physical and roentgenological examinations were entirely negative so far as the chest was concerned. His case was diagnosed as one of chronic cholecystitis. He was operated on the morning of November 4 (by H. M. R.). He had received one dose of morphine, grains ¼ and scopolamine, grains 1/150, 1½ hours before the operation, and another 1 hour later. An attempt was made to operate under gas anæsthesia, aided by local infiltration with novocain, ¼ per cent in normal salt solution. Because of muscular rigidity ether had to be resorted

Fig. 1. Roentgenogram of patient taken November 7, showing massive collapse of the lung.

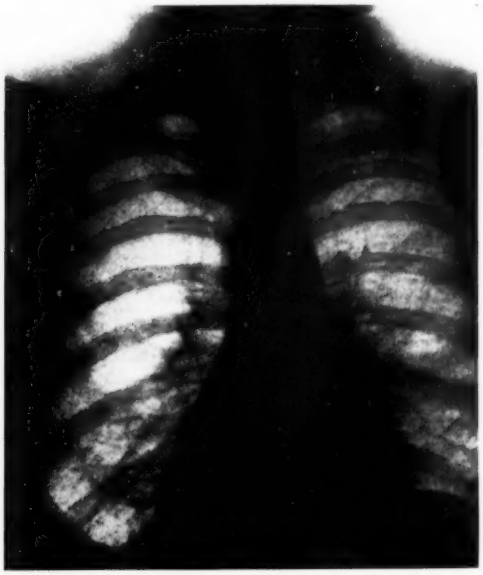

Fig. 2. Roentgenogram of patient taken November 17, showing heart and lungs normal.

to. The usual gall-bladder incision was made and a frankly pathological gall bladder was removed. The appendix was removed through a separate muscle splitting incision. The amount of ether used was 8 ounces, the duration of the operation 55 minutes.

The next day the patient was somewhat restless, the afternoon temperature reached 100.6 degrees F. and the pulse 96. He complained of tightness across the chest. He was very restless that evening, and coughed occasionally during the night. At 7 a. m. the following morning the nurse recorded that his respirations were shallow and rapid, 36 to a minute, his pulse was 120, and temperature 102.2 degrees F. He looked anxious and sick, the alæ nasi were working. Examination revealed dulness over the right lobe. The breathing was very quiet, hardly audible. A beginning consolidation was suspected.

November 7. The lowest temperature was 99.8 degrees F. and the highest in the evening was 102.6, the pulse varied between 92 and 120, respirations 24 to 32. The following notes were made: "Examination revealed a very striking hyperresonance over the cardiac area. Cardiac dulness has shifted markedly to the right. The apex beat is difficult to feel but as nearly as can be made out is about 4 centimeters inside the mammary line. In other words, the heart is retracted toward the right. The right side of the chest is immobile and retracted. It is resonant to percussion, the breath sounds, however, are markedly suppressed. Transmission of the spoken voice is somewhat exaggerated. The left side is hyperresonant throughout. The condition warrants the diagnosis of massive collapse of the right lung."

The patient coughed occasionally and brought up with great difficulty a very small quantity of grayish mucopus. He exhibited very little dyspnœa except when he was turned on the affected side. This resulted in a most urgent dyspnœa and a fit of coughing.

November 8. The condition was unchanged except that the left border of the heart was now at the midsternal line. Roentgenological studies (Fig. 1) revealed the following: The left thorax was clear. It was noted that that portion of the heart which usually lies to the left of the median line had entered the right thorax. The right lung field was almost entirely obliterated with the exception of the small amount of aerated lung in the upper right periphery. The lower portion of the lung was occupied by a diffuse density. The heart and aorta lay in extreme dextrocardia.

The patient improved every day so that on November 10 he was afebrile, the pulse was 88, and respirations 22. Examination of the chest on November 17 revealed a normal condition of both lungs and of the heart. X-ray films (Fig. 2) taken the same day showed a perfectly normal condition. Both lungs nearly filled the thoracic cavity. Both pulmonary fields were of approximately normal transparency. The heart and aorta likewise were seen to be normal and there was no evidence of a pleural lesion.

CONCLUSIONS

1. Postoperative massive collapse of the lung is a well recognized condition.

2. It occurs most frequently after abdominal operations.

3. The cardiac displacement toward the affected side is its most characteristic physical sign.

4. It would at least seem logical, with the view of preventing shallow breathing, to carry out systematic breathing exercises in all postoperative cases, and to abandon the method of fixing the dressings after laparotomies by tightly strapping the abdomen and the lower half of the chest with adhesive strips.

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AIDS IN PREDICTING THE DEGREE OF POSTOPERATIVE THYROID REACTION

A Study Based on 1,000 Consecutive Cases

By L. F. SISE, M.D., Boston, Massachusetts
From the Lahey Clinic

IN operations on patients with thyroid toxæmia, one of the great difficulties which confronts the surgeon is the reaction of the patient to operation. This postoperative reaction varies considerably in type and extent, but it always carries the threat of death.

A good deal can be done when once these reactions have started, but if they are of sufficient intensity, or if the patient's resistance is unduly low, death may ensue in spite of all that can be done. Prophylaxis is better than therapeusis. A more certain method than the care of the reaction after it has started is to prevent its occurrence or to lessen its severity. This can be done by adapting the operation to the condition of the patient.

If a thyroidectomy or hemithyroidectomy is likely to result fatally, a ligation of the superior poles, or even of only one pole may first be done. When the patient has received the benefit of this operation, a more extensive one can be done, removing part, or even the whole of the gland. This is the multistage scheme of operation. With this scheme, however, when the surgeon is uncertain how much reaction will follow a given operation, he is confronted with the following dilemma: either he may subject the patient to an unnecessary number of operations, with the attendant expense and delay; or, in his desire to avoid this, he may do too much and jeopardize the patient's life. It is easy to see, therefore, that the success of this scheme of operating depends, to a very large extent, upon the certainty with which the postoperative reactions can be predicted.

Most of the published work on the foretelling of postoperative reaction has been concerned with the pre-operative study of the patient . So far as I know, nothing has yet been done toward a definite study of the patient's behavior under operation and anæsthesia. This is mentioned only incidentally in the course of articles on other subjects.[1] Yet much can be deduced from it. The patient's behavior is a test of her capacity of adjustment to the somewhat trying conditions of anæsthesia and operation. She is here seen under the worst conditions, and her behavior under these conditions may throw considerable light on the severity of her postoperative reaction and on her power of resistance to this reaction.

In this clinic an attempt has been made to predict from the course of the anæsthesia the amount of postoperative reaction. This attempt has been fairly successful. The reactions were found to be roughly proportionate to certain signs occurring during the course of the anæsthesia. But occasionally patients were seen whose behavior under anæsthesia was apparently favorable, who, nevertheless, had severe postoperative reactions. Some of these had little or no reaction of the ordinary sort, but remained quiet, apathetic, or unconscious, and died. This was disheartening and confusing. These few cases seemed to upset the criteria which we had been using in our attempt to foretell the postoperative reaction.

This paper is an attempt to clarify this situation, to ascertain more definitely the meaning of the various signs during anæsthesia, and, especially, to study the occasional cases just mentioned. Are these cases just freaks which cannot be detected? Are they essentially different from the others, but with characteristic signs which perhaps can be detected? Or, do they follow the same general laws as the others, and have we, perhaps, not yet learned their position under these laws, or how to use the signs obtained?

[1] Hunt. Goiter risk. Am. J. Surg., 1924, xxxviii, Anesthesia Supplement, p. 12.

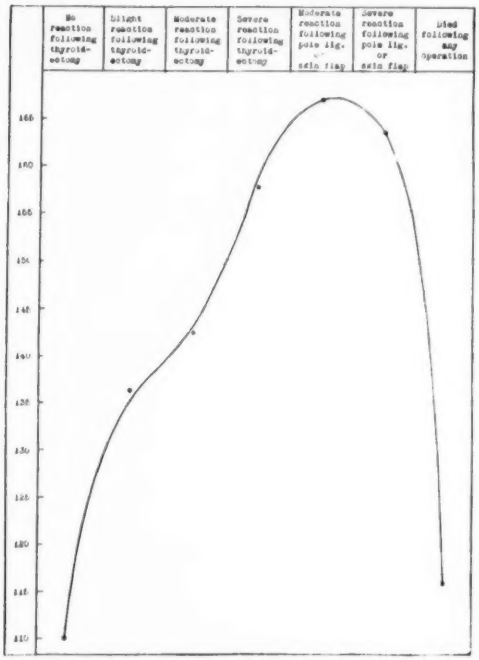
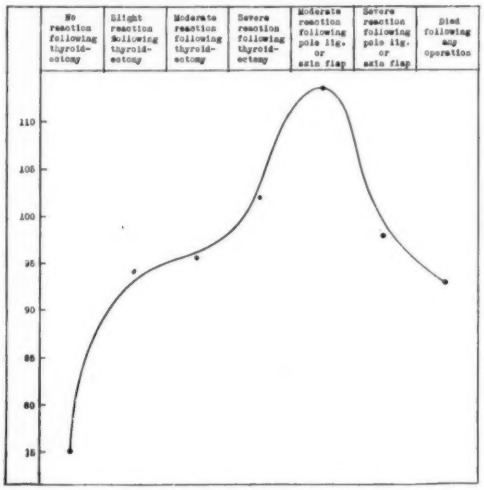

No reaction following thyroidectomy
Slight reaction following thyroidectomy
Moderate reaction following thyroidectomy
Severe reaction following thyroidectomy
Moderate reaction following pole lig. or skin flap
Severe reaction following pole lig. or skin flap
Died following any operation

Fig. 1. Pulse rate.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Died following any operation

Fig. 2. Pulse pressure.

The material used in this study consists of the anæsthesia records of 1,000 consecutive thyroid cases. The anæsthesia used in all cases was nitrous oxide-oxygen preceded by a narcotic. The narcotic generally used was morphine, ¼ grain, and scopolamine, 1/200 grain, 2 hours before operation, and again 1 hour before operation, making a total dose of ½ grain of morphine and 1/100 grain of scopolamine. These amounts were lessened for various conditions such as weakness, age, heart disease, etc. A graphic chart was kept of every anæsthesia, recording the pulse, respiration, and blood pressure, and also the patient's appearance on coming to the operating table, whether of normal color or flushed, awake or asleep, excited, restless, etc.

The method of study was to divide the thousand records into groups based on the postoperative reaction and the kind of operation. In doing this the groups were arranged, as far as possible, so that there should be a gradual increase from group to group in the amount of postoperative reaction following the same amount of operating. To do this absolutely was, of course, impossible, as the amount of operating varied with different patients; but it was approximated as far as possible. It will be noticed that in so doing a moderate reaction following a prel minary operation, such as ligation of a thyroid pole, was considered of more significance than even a severe reaction following an operation on the thyroid gland itself. The first group included those patients showing no reaction to an operation which was done directly on the thyroid gland, the second group those showing a slight reaction to such an operation, the third group those showing a moderate reaction, and the fourth group those showing a severe reaction to such an operation. The fifth group included those showing a moderate reaction to a preliminary operation, such as ligation of poles or raising of skin flap, and the sixth group those showing a severe reaction to a preliminary operation. The seventh group included all who died from an operation of any type. In this series all those in the last group had an operation directly on the thyroid gland. Inasmuch as the number of those showing no, or slight, reaction was very large, only a sufficient number of each of the first two groups was chosen to act as an average

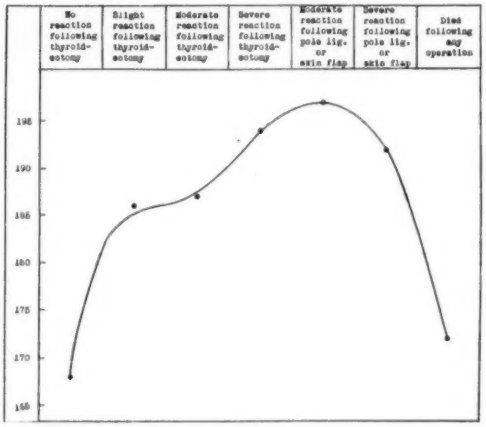

Fig. 3. Systolic blood pressure.

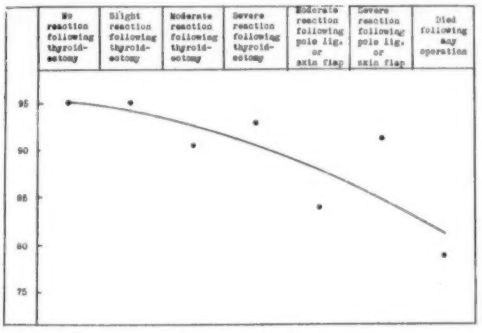

Fig. 4. Diastolic blood pressure.

sample for the total number. Each of these groups contained 30 cases chosen at random. The third group contained 57 cases, the fourth, 9, and fifth, 18, the sixth, 7, and the seventh, 5 cases. The observations for each group were then plotted on graph paper, with the groups in order for the abscissæ and the appropriate scale of numbers for ordinates. The results are shown in Figures 1, 2, 3, 4, and 5.

Rather definite curves were obtained. While the observations in some of these curves do not run very close to the line of the curve, they are for the most part sufficiently close to indicate very definitely the tendencies of the readings in the different groups. The average observation for a given group sometimes does not come on or near the curve, because of the individual variations in different cases, combined with the comparatively small number of cases in some of the groups, and also because of the occasional uncertainty in assigning a case to the proper group on the basis of postoperative reaction.

Four out of five of these curves show a similar tendency. The curve is fairly sharply reversed on itself. In the first three curves the first five observations form an ascending line, and the last two a descending one. The sixth, or next to the last group, is nearly down to the seventh in one curve (Fig. 2), nearer the fifth than the seventh in one (Fig. 3), and quite near the fifth in another (Fig. 1). In the last curve (Fig. 5), the sharp part of the curve, where it reverses its direction, is nearer the beginning than in the first three curves, as only the first four groups form the ascending line, while the last three form the descending. This variation in the position of the sixth group in the first three curves, and the slightly different position of the sharp part of the curve in the last one, tend to indicate that the ascending line changes into the descending by means of a curve instead of an angle.

The remaining curve, showing the diastolic blood pressure (Fig. 4), is the least perfect of the five, many of the observations being badly off the line of the curve. It is entirely different in character from the other four, as it lacks the sharp reverse seen in them.

In Curves 1, 2, 3, and 5, the ascending part of the curve applies to a large group of patients, comprising the great majority of all cases, and indicates what is soon evident in watching these anæsthesias, namely, that an increase of pulse rate, systolic blood pressure, pulse pressure, or respiration indicates an increased likelihood of postoperative reaction. The descending part applies to a small group whose postoperative recovery is poor. Here the indications appear to be reversed, for the lower the readings are the worse is the postoperative outlook. The curves as a whole indicate the relations between these two groups and show the tendencies and values of the various observations.

From a study of the individual curves, some idea may be gained of the meaning and value

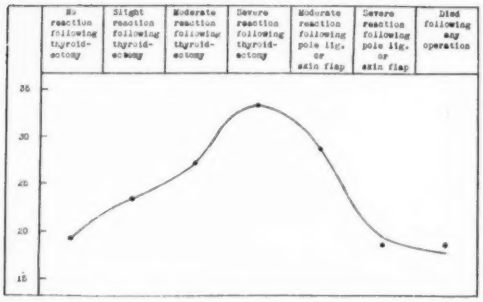

Fig. 5. Respiration rate.

of the sign represented by a given curve. The greatest excursion is shown by the pulse. Thus in this curve there is a greater difference between the different groups than there is in any other curve. For instance, there is more difference in the pulse between Groups 1 and 2 than there is in the pulse pressure or blood pressure between these same groups. And the same holds true for most of the other groups. This should mean that the pulse is the most sensitive indicator of reaction. This agrees with clinical experience which has shown that the pulse rate is the most sensitive and reliable single guide available.

The pulse pressure shows the next greatest excursion, and here again this agrees with clinical experience, which is that, second only to the pulse rate, the pulse pressure is the best guide.

Only slightly lower than the pulse pressure curve is that of the systolic blood pressure. This agrees only partly with clinical experience, for while it is next in value to pulse pressure in practical work, it is not close to it in value as indicated by the curves, being on the contrary, considerably below it. The reason for this is the effect of cardiovascular disease on the blood pressures and the not infrequent incidence of such cases. In them the systolic blood pressure is often greatly elevated entirely independently of toxicity or of potential postoperative reaction. But the diastolic pressure is also elevated, so that the pulse pressure is not increased in proportion to the increase in the systolic. Therefore, an increase in systolic blood pressure is indicative of reaction only in proportion as it is accompanied by an increase in pulse pressure.

The respiration curve shows the least excursion of any of the curves that reverse on themselves. In practice the rate of respiration has seemed to be of very little value, and of considerably less value than the character of respiration.

The diastolic blood pressure curve shows such a slight excursion that individual variations of different cases greatly exceed the difference between the groups, and make this sign of little or no value. This, again, agrees with clinical experience.

In looking at Curves 1, 2, 3, and 5, we are struck by the fact that in Group 7, consisting of the 5 patients that died, the pulse rate, the systolic blood pressure, and the respiration are very near in height to the first group, the group that had no reaction. They are nearer this group than they are to any group which had reaction. The pulse pressure in Group 7 is close to that in the groups which had slight or moderate reaction. Only in the diastolic blood pressure is the last group further removed in value from the first group than are any of the others, and the diastolic blood pressure is of little value as explained above. The position of the last group in this curve, however, suggests the possibility that, while the diastolic blood pressure has been of little clinical value in the past, a closer study of it may serve to differentiate this last group of those that do badly from the other group, which, while showing similar anæsthesia charts, does very well.

We have just said that the first part of many of our curves, a part which represents patients with the very best postoperative recoveries, is about on a level with the end of these same curves, which represents those patients that died or did very poorly. These two groups of patients, being at about the same height in the curves, evidently show readings of about the same character during anæsthesia; and yet their postoperative recoveries are absolutely different. It is, therefore, very important to differentiate these two groups one from the other. Let us then, for purposes of study, reclassify our original groups into these two new groups, which

correspond to these two portions of our curves. The first of these newer groups is composed roughly of the first of the original groups with some of the second and third. The second of these newer groups is composed of the seventh original group and perhaps some of the sixth. Here, then, we have these two groups which it is vitally important, clinically, to differentiate one from the other; and yet we have little in the anæsthesia charts to help us do it. This is the peculiar and striking fact brought out by these curves.

However, these two newer groups can be differentiated with a fair amount of certainty by the appearance of the patients on coming to the operating table and by the depth of anæsthesia necessary during operation. Patients in the first of these two groups, the one which is destined to have a comparatively slight postoperative reaction, come to the table with a normal color or only a slight flush, and in a rather drowsy condition from the preliminary narcotic. These patients awaken readily on being disturbed, but quickly fall asleep again when left alone. Occasionally they remain definitely awake and they are seldom sound asleep. There is nothing unusual about the depth of the anæsthesia required, just the ordinary average depth. These patients react somewhat to the various operative procedures, requiring greater depth if there is traction or other disturbing procedure. In the second of these two groups, the chart shows the same moderate readings, but the patient is destined to have bad reactions with high mortality if much is done, is usually deeply flushed by the preliminary narcotic on coming to the operating table, and is sound asleep. Sometimes the patients seem really unconscious and do not rouse in the slightest, even when transferred from the truck to the table. Naturally, under these conditions, they require very little anæsthetic during the operation, and they show little or no reaction during anæsthesia to various operative procedures. They run smoothly and easily and on so weak a mixture that they are usually a bright pink in color. Great caution should be exercised with patients in this condition.

In general, while there are wide individual variations in the depth of anæsthesia, the first of the original groups requires the deepest anæsthesia and the seventh the lightest, with the depth decreasing fairly evenly.

Observation of the patients themselves before operation serves to differentiate these two newer groups with still more certainty. Pre-operative study of thyroid patients has been discussed elsewhere so thoroughly that it is unnecessary to take it up in detail here. It is sufficient to say that the small group of patients with high mortality is of the type that appears apathetic and exhausted. Their vitality is apparently so low that they lack the capacity to run the high pulse and blood pressure seen in the higher parts of the curves. Neither do they get the asthenic activated type of postoperative reaction. If the operation proves too severe an ordeal for them, they remain quiet, apathetic or unconscious, and die without the restlessness and activity seen in the more usual form of thyroid storm. The other newer group of patients with which this group might be confused if reliance is placed only on the anæsthesia record, is pre-operatively a comparatively well group, not easily confused with this apathetic and exhausted group.

If we return to the question propounded early in this paper, whether the few unusual cases mentioned are governed by the same general laws as the others, we apparently can say that they are. These cases appear mainly in the seventh with probably some in the sixth of the original groups. We have found that the anæsthesia readings of these seven original groups, when plotted as graphs, form definite curves with the groups arranged in regular order from one to seven. Therefore, it seems highly probable that these occasional unusual cases which group themselves at the end of these curves are not in themselves essentially different from all the others, but are simply the end product of thyroid toxæmia. They are the exhausted remnants, left from the conflict with the disease, with too little remaining strength to react in the usual way to the stimulation of anæsthesia and operation.

Of course no claim is made that just these curves would be obtained in any series of

toxic patients. In fact, if, in this same series, the apathetic cases had been regarded with more caution and the activated type treated with less, the descending part of the curve would undoubtedly have been shorter. And no claim is made that these curves form a rule of thumb by which alone the postoperative reaction can be accurately gauged. Individual variations are too great. But clinical experience shows that in any anæsthesia there will be at least one sign giving a definite indication of any considerable postoperative reaction, and the likelihood and intensity of postoperative reaction is roughly in proportion to the number and intensity of the signs indicating such reaction. It is believed that these curves do bring out the significance of certain of the more important factors useful in reaching an accurate postoperative prognosis and present them to the eye in a somewhat striking form.

CONCLUSIONS

1. In the great majority of toxic thyroid patients, under nitrous oxide-oxygen anæsthesia, with the technique used in this clinic, a postoperative reaction is indicated, roughly proportionate to the increase above normal in pulse rate, pulse pressure, systolic blood pressure, and respiration.

2. In a small group of patients the disease has apparently progressed beyond the condition in which this is true. With them the postoperative reaction and especially the postoperative mortality is roughly in *inverse* proportion to the increase in the pulse rate, pulse pressure, systolic blood pressure and respiration.

3. This small group is asthenic and apathetic and their operative mortality is high.

4. A much more accurate forecast of the postoperative reaction of toxic thyroid patients can be made by taking into account both the pre-operative condition of the patient and the course of the anæsthesia than can be obtained from either of these procedures alone.

The charts all show readings at operation which precede various amounts of postoperative thyroid reaction. As nearly as possible the reaction to a given amount of operating increases steadily from left to right. This is shown at the top of the charts. The scale for reading the curves is at the left. It will be noticed that in the pulse rate, systolic blood pressure, and respiration rate, while there is a wide excursion in the middle of the chart, yet the two end ones representing those patients having no reaction and the other representing those who died, have approximately the same reading, and in the pulse pressure, the same tendency, though less pronounced, is also apparent.

CHRONIC PEPTIC ULCER IN CHILDREN[1]

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SINCE a century ago, when our knowledge of peptic ulcer as a clinical entity began, isolated and infrequent cases of gastric and duodenal ulcers in children have been reported. The condition was regarded as extremely rare, and it is only in the last 15 or 20 years that ulcers of the stomach or duodenum in children, from all causes, and acute or chronic, have been noted more frequently. Chronic peptic ulcer, however, remains rare. With very few exceptions the ulcers reported were found at necropsy. A small number have been discovered during operations, and a very small number have been diagnosed clinically.

A careful review of the literature shows that, until recently, all ulcers, from whatever cause, and whether acute or chronic, were reported together in series. An exclusive study of chronic peptic ulcer in children has not been made, and yet clinically, this is by far the most interesting type.

I shall here consider an ulcer chronic, only when symptoms or signs of its existence have been present two months or longer, or when an ulcer without symptoms, or symptoms of short duration, is calloused or indurated, with raised edges, or has sufficient adhesions to neighboring structures of a character which leave little doubt that the process is chronic. The patients in the series are 14 years of age or younger. It would seem almost superfluous to mention this, but for the fact that certain writers include in their cases of ulcer in children patients 15, 16, and even 18 years old.

Ulcerations which are an incidental part of a generalized tuberculosis, or of an acute or chronic infection, in which the ulcer is a secondary or antemortem condition will not be considered here, even if possible symptoms of it have been present, as rarely happens, for as long as 2 months. Also, cases of an ulcerative process affecting the gastro-intestinal tract as a whole, and only incidentally the stomach, will be excluded.

Among the other conditions causing secondary ulceration of the stomach or duodenum, and not the true peptic ulcer, such as burns, uræmia, and so forth, I find no cases which could be construed as chronic. Although the literature is extensive, I have found reported only 19 cases which, judged by the standards already mentioned, could be regarded as chronic peptic ulcers in children, and 2 cases which are questionable. These are briefly as follows:

Rufz, 1843. A girl, aged 13 years, had had symptoms for 2 years, when perforation and death occurred. Ulcer was found on the lesser curvature of the stomach.

Verliac, 1865. A boy, aged 14 years, had had digestive disturbances for 2 years; during the month before he died the symptoms were very severe. Necropsy revealed perforating gastric ulcer.

Fischer, 1900. A girl, aged 14 years, had had symptoms for 3 years. There was relief from treatment, then relapse, and then cure up to the time of the report.

Bechtold, 1904. A girl, aged 5 years, had had symptoms for 5 months, and then developed acute peritonitis. Drainage for appendicitis was followed by death. At necropsy perforation of ulcer on the greater curvature of the stomach was found.

Von Eiselsberg, 1905. A girl, aged 12 years, had had symptoms for 1 year. Recovery followed operation; she had been well 3 years at the time of the report.

Robinson, 1905. A boy, aged 14 years, died after 1 year of illness. Multiple ulcerations of stomach were found.

Leary, 1907. A girl, aged 7 years, had been ailing about a year, when she had a sudden profuse hæmorrhage from which she recovered.

Adler, 1907. A girl, aged 8 years, had had hæmorrhages for 10 weeks. She was placed on medical treatment for 5 weeks, and recovered. She had been well 5 months at the time of the report.

Parmentier and Lasnier, 1908. A girl, aged 12½ years, had had symptoms for more than 8 years. She was treated in a hospital for 9 months, and was dismissed, apparently cured.

Lund, 1909. A boy, aged 8 years, had had trouble for 1 year. Operation disclosed a large gastric ulcer, adherent to the liver. The boy recovered.

Bichât, 1910. A girl, aged 14 years, had had symptoms for 3 or 4 years, then suddenly developed peritonitis. Operation revealed a perforated duodenal ulcer; she recovered.

Von Cackovicz, 1912. A boy, aged 14 years, had had symptoms for 7 years. At operation fixed stenosis of the pylorus was found. The boy recovered.

Von Cackovicz, 1912. A girl, aged 13 years, had had symptoms for 2 years. Operation revealed a stenosis of the pylorus with scarring. The patient recovered.

Theile, 1919. A girl, aged 13 years, had had symptoms for about 4 months when perforation occurred. Operation was performed for supposed appendicitis, and the perfora-

[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, June, 1924.

tion was found on the anterior wall of the stomach near the lesser curvature. The patient recovered.

Sanjek, 1920. A girl, aged 12 years, had had symptoms for more than a year. At operation pyloric stenosis from gastric ulcers was found. The patient recovered.

Alsberg, 1920. A girl, aged 2 years, had had a sudden attack of pain and bleeding. Operation revealed the bowels to be full of blood, and an old duodenal ulcer scar near the pylorus, with adhesions to the liver. The child recovered.

Palmer, 1921. A baby boy, aged 6 months, had had symptoms almost from birth. Operation revealed a typical ulcer scar on the duodenum 1.25 centimeters from the pylorus, with a tag of adherent omentum. Pyloroplasty was performed, with temporary improvement, then gastro-enterostomy with cure. The child was normal at the age of 2.

Carro, 1922. A girl, aged 8 years, after having had symptoms for 2 years was operated on for pyloric ulcer; she recovered.

Norrlin, 1923. A girl, aged 7 years, had had trouble for 3 years, when sudden severe pain with peritonitis occurred. Operation revealed a large callous ulcer of the pylorus with perforation. The child recovered.

QUESTIONABLE CASES

Guns, 1862. A boy, aged 5 years, had had indefinite symptoms for several months, when pain in the belly, slimy vomit, and diarrhœa occurred. He was placed in a hospital where he contracted scarlet fever. Ulcers appeared on the gums and tongue; then suddenly, bloody stools and death. Ulcer was found on the posterior surface of the stomach near the pylorus.

Reimer, 1876. A girl, aged 3½ years, had had digestive disturbances for more than 2 years. On admission to the hospital she had fever, tender belly, slimy stools, and was vomiting. She recovered and contracted measles. Stools became bloody and black, and the child died.

MAYO CLINIC CASES

In the Mayo Clinic from 1906 to 1924, 8,260 cases of peptic ulcer were observed, of which only 2 were in children. Of a total of 1,596 gastric ulcers, 1 was in a child (Case 1). Of 6,664 duodenal ulcers, only 1 occurred in a child (Case 2). A third case is also one of duodenal ulcer; although the first and third attacks were associated with coryza, and the second with tonsillitis; it seems that the ulcer was a chronic process activated by the infections, and not that three separate acute ulcers were formed with each of these infections.

CASE 1. A boy, aged 14 years, came to the Mayo Clinic July 16, 1923, because of loss of appetite and abdominal pain. The maternal grandmother had died from cancer, and the mother had duodenal ulcer. The patient had had measles and mumps, and influenza with slight jaundice in 1920. In 1922, the tonsils and adenoids had been removed. He had always been undernourished because of lack of appetite. At the age of two he had had an attack of abdominal pain, which caused him to cry all night. He had never been strong and rugged, and had always been somewhat constipated. Six years before coming to the Clinic, he began to have attacks of pain in the abdomen. The next year he was free from the attacks; they had recurred since then, for 10 or 12 days at a time, with free intervals of as long as 6 months. Recently the attacks had become longer and closer together, and at the time of examination there was very little free interval. The worst trouble had always been just after school was out in June. A dull, cramping, grinding pain would come on rather suddenly, and usually in the region of the navel, where it was most severe, and sometimes caused tenderness. The pain radiated over the lower abdomen, especially to the right. It lasted from a few minutes to one-half hour, never longer. At times it was severe enough to make the patient cry. The pain often came on one-half hour after meals, and sometimes about 2 or 3 o'clock in the morning, although there was no regularity to its appearance. There was slight food ease, but no soda ease; most relief was obtained from doubling up, from the use of a hot water bag, or from lying flat with a pillow under the abdomen. There were no hunger pains. Jarring of any kind usually brought on the pain. During the last 6 months the attacks were accompanied by vomiting, which afforded some relief. The vomitus consisted of sour watery material, but no blood nor food. The patient was not subject to sour stomach, and had had very little belching. On two occasions during the last 2 weeks before examination, the returns from the enema had been as black as tar. There had recently been slight loss of weight.

At examination the child was poorly nourished; there was a definite spot of tenderness to deep pressure 3.75 centimeters to the right of, and slightly above the umbilicus. Retardation of development was marked. The urine, blood, Wassermann and tuberculin tests were negative; also the stool test, proctoscopic examination, and colon ray. There were plugs in a remnant of the right tonsil, and a slight dental infection. A test meal revealed 24 combined acid, and 14 free hydrochloric acid, a total of 65 cubic centimeters. The X-ray and re-ray showed a lesion at the pyloric end of the stomach. The parents were advised to keep the boy outdoors a good deal, and to force nourishment. He returned to the clinic October 10, having gained 3 pounds, but with all symptoms worse, and persistent anorexia. A roentgenogram of the stomach revealed the same lesion of the pyloric end. At operation, October 17, a typical ulcer of the chronic penetrating type, with callus and induration, was found about 5 centimeters above the pylorus. The ulcer was excised, and the opening closed with chromic catgut and silk. A posterior gastro-enterostomy was made. The pathologist's report was simple gastric ulcer, 11 millimeters in diameter.

Since operation there has been no return of the former trouble, and the patient gained 21 pounds in 2 months following operation; his general condition is also better.

CASE 2. A boy, aged 13 years, came to the clinic in October, 1914, because of stomach trouble of 4 years' duration. He had had whooping cough, and his appendix had been removed 3 years before. The stomach trouble consisted of a dull, dragging, epigastric pain and vomiting, which the father believed would have continued without treatment. The patient had free intervals of 6 months, but was worse in the winter. During the last 3 months he had vomited practically every night between 10 and 3 o'clock. The vomitus was very sour, and as a rule, larger in quantity than the food intake; it never contained blood. Vomiting relieved the pain, as did soda, and at times, drinking water. Occasionally the patient vomited immediately after meals. He was very constipated. During attacks, the patient lunched between meals, but not on account of pain. Between attacks he did not do so.

At the time of examination, the patient was thin and tall, and weighed 76 pounds. The urine and blood were normal. A test meal revealed combined acids 50, and free hydrochloric acid 36. The roentgenograms revealed a pyloric obstruction with retention 2 after 6 hours. The stomach was large, and the antrum dilated. Peristalsis was inactive.

At operation October 7, an ulcer of the duodenum was found to extend around the pylorus, with great thickening and contraction. There was general mesenteric enlargement of the lymph nodes. A posterior gastro-enterostomy was made, and the ulcer covered.

Convalescence was uneventful, and in 1922 the patient, who was just out of the army, was in excellent health. He weighed 175 pounds, and had never had any return of gastric symptoms.

CASE 3. A boy, aged 2 years, was brought to the clinic because of a cold accompanied by sudden vomiting of blood. When a few days old, he had received a burn from a hot water bottle, which did not heal for weeks. He had also received a course of mercurial injections from a doctor, for a supposed congenital syphilis. There was never any evidence of this, and two Wassermann tests on both father and child gave negative reactions.

The child was admitted to the hospital. He was extremely weak, with an irregular and thready pulse. Pallor was marked and the breathing was deep and sighing. The stools contained black and red blood. Fluids were given subcutaneously, horse serum intramuscularly, and soon after, a transfusion of 200 cubic centimeters of blood. For many days there was blood in the stools, and the child would vomit milk and other foods. A diagnosis of duodenal ulcer was made, and the Sippy treatment instituted. The blood count gradually rose, and the child was sent home on a diet, and alkaline powders were given.

At the age of 2½ years, the patient developed a sore throat and fever, and within 24 hours of this vomited about 240 cubic centimeters of dark red blood. The stools also contained blood. He returned to the clinic very anæmic and listless, and with a weak pulse. He was given a transfusion of 75 cubic centimeters of blood at once, and later a transfusion of 350 cubic centimeters. Blood continued to appear in the stools. The hæmoglobin was down to 35 (Sahli). Two days later, a hæmorrhage from the nose and throat occurred. The patient was put on medical treatment, and was discharged cured. His blood had gradually improved.

Fig. 1. Gastric ulcer from Case 1. *a*, Anterior view; *b*, lateral view; and *c*, sagittal section.

At the age of 4 the child was again admitted to the clinic. He had been well, and had gained in weight, but the day before admission, had developed a cold with fever. In the morning he had a severe hæmorrhage, vomiting 360 cubic centimeters of coagulated and red blood, and also had very large movements of what appeared to be pure blood. He was very anæmic and listless. A transfusion of 350 cubic centimeters of blood was given, and medical management instituted. Gradually, in the course of 2 weeks, despite another transfusion, he developed bronchopneumonia, and died.

There was never any evidence of any condition other than ulcer to account for the bleeding, and the diagnosis was clear. Necropsy was refused.

ETIOLOGY

It is probable that the cause of chronic peptic ulcer in children is essentially the same as in the adult. In the cases reported in the literature two-thirds of the patients were females, a ratio which may be due merely to the relatively small number of cases recorded.

Predisposing factors, which are supposed to have an influence in the adult, are certainly

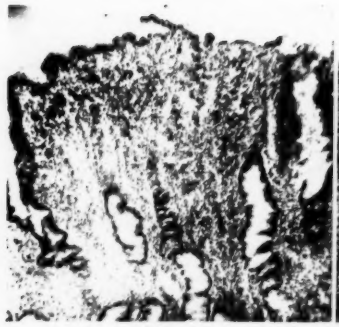

Fig. 2.

Fig. 2. Low power view of microscopic section of the mucous membrane of the stomach, showing inflammatory reaction.

Fig. 3.

Fig. 3. Low power view of crater of ulcer.

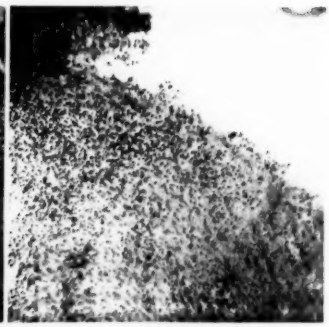

Fig. 4.

Fig. 4. Low power photograph of base of ulcer, showing reaction and fibrous tissue.

much less common in children, and this may have some bearing on the rarity of the condition in children. The factors of worry and strain, tobacco, alcohol, very highly seasoned foods, and so forth, are usually entirely absent. Huber compiled statistics tending to show the influence of heredity. While this is questionable, it is interesting to note that in the first case in the Mayo Clinic series, the mother of the boy had a duodenal ulcer.

It is always possible, that under favorable circumstances, an acute ulcer may become chronic. A large number of conditions have been found to be responsible for acute ulcers of the stomach and duodenum in children. Trauma has been thought to play a part, and several cases are recorded in which it was definitely responsible for the rupture of an acute ulcer (13). The swallowing of caustics and foreign bodies had been noted by Jacobi and many others as a cause. Malnutrition and pedatrophy have already been mentioned. Fenwick, Simmonds, and others, have reported gastric and duodenal ulcers following burns, but the condition is not very common, according to the statistics of those who have performed necropsies on large numbers of children dying from burns.

Acute infections of all kinds have been responsible for ulcers. Cases of acute gastritis, septicæmia, scarlet fever, measles, pneumonia, meningitis, tonsillitis, influenza, and so forth, have been reported in which there has been found at necropsy acute peptic ulcer, as well as the cases reported by Gerdine and Helmholz, which seemed to be epidemic in nature. Chronic infections have also been causative, and Imerwol and others have recorded ulcers in cases of nephritis and uræmia.

Hyperacidity is less common in children than in adults, particularly in the first few years, according to the extensive work of von Hecker, Bauer and Deutsch, and other investigators. This is especially true in various pathological conditions. In Cases 1 and 2 of the Mayo Clinic series, in which gastric analyses were made, there was no hyperchlorhydria. The motility of the child's stomach is thought to be greater than that of the adult.

PATHOLOGY

The location of practically all the gastric ulcers (the 16 collected from the literature and Case 1 from the Mayo Clinic) was on the lesser curvature at, or near, the pylorus, the usual location in the adult. One was on the anterior wall near the lesser curvature and the pylorus; one was on the greater curvature near the fundus; and in the only case of multiple ulcers, the lesion was at the cardia. The duodenal ulcers were all on the anterior surface of the first portion of the duodenum, near the pylorus, with the exception of one which had perforated the second portion of the duodenum.

The gastric ulcers ranged from 1 to 3.5 centimeters in diameter. No duodenal ulcers were excised, nor did any come to necropsy.

Approximately one-third of the gastric ulcers had perforated; one of these onto the spleen, and one onto the pancreas; in all cases of perforation there was general peritonitis. One duodenal ulcer had perforated onto the liver. There were adhesions of greater or lesser extent around all the ulcers. The gastric ulcers were practically all of the type ordinarily seen; a typical specimen is shown in Figure 1. The thickening of the walls, the rounded edges, and the deep crater are evident. The microscopic sections (Figs. 2, 3, and 4) show the inflammatory reaction, both in the mucous membrane of the stomach and in the deeper layers, also the extensive fibrosis at the base.

Approximately one-third of all the ulcers were associated with definite stenosis of the pylorus, usually of considerable degree, and one ulcer had produced marked stenosis at the cardia.

There has been no indication that any of the gastric ulcers become malignant during childhood. Of the 2,833 cases of carcinoma of the stomach, including malignant ulcers, seen at the Mayo Clinic from 1906 to 1924, the youngest was 18 years old.

Fig. 5. Roentgenogram showing gastric ulcer on lesser curvature.

SYMPTOMS

The onset of symptoms may be sudden, with the advent of hæmorrhage or perforation, and one may not be able to bring out any history of previous dyspepsia, or complaints referable to the stomach. This, however, is very exceptional. It may be that in these cases mild digestive disturbances are disregarded, or forgotten by the child. There is usually a history of stomach trouble extending over a period of months or many years, the longest time noted being 8 years. Generally, the trouble comes in attacks of variable length, and in some cases there is a seasonal incidence, the attacks being worse in spring and fall, or winter. There are usually intervals of fairly good health.

The symptoms may be mild and attract little attention, as in one case in which pallor, failing appetite, and loss of weight, with occasional vague abdominal pain, were the only complaints preceding perforation. As a rule, however, symptoms are very definite, and at times severe.

Epigastric distress, or pain, varying from a dull, vague feeling of discomfort to acute pain, is present in practically all cases. It is usually dull to sharp, often cramp-like or boring, and may be localized, or radiate to other parts of the abdomen, or to the back. The duration varies widely, from a very short period to several hours. As a rule, the pain comes on from 1 to 3 hours after meals, but it may come on at any time. Often it is present at night, and wakes the child at 2 or 3 in the morning. Definite hunger pains are rather commonly noted. The pain is usually relieved by food, and the child eats between meals to ease the distress. In 1 case, even at the age of 4, the girl used to take food during her parents' absence, to relieve the pain, and would repeat this as long as the attack lasted. Soda, when tried, has seemed to give less definite results. Vomiting usually eases the pain, for a short time, or for several hours.

Gas, bloating, and belching do not seem to be prominent symptoms in children, but are not infrequently present.

Nausea and vomiting are present in most cases. The vomiting usually comes not long after a meal. The vomitus is sour, as a rule, but seldom so much so as to cause a severe burning sensation. There is rarely a retention

type of vomiting, the material being simply that taken at the last meal, or gastric contents and mucus. The frequency of vomiting as a prominent symptom is probably partly accounted for by the fact that few cases are diagnosed, or suspected of being serious lesions until some prominent objective condition becomes manifest.

Constipation is the rule, and is often obstinate. Loss of appetite is a symptom frequently encountered. In many cases, weakness or exhaustion, is complained of.

Retardation of development is often striking, and depends largely on the duration of the condition and the age at which it began. In Case I (Mayo Clinic series), the boy, with a 6 year history, looked stunted and several years younger than he was. In the case of Parmentier and Lasnier, in which symptoms had been present 8 years, the child looked 4 or 5 years younger. The influence of the condition may be such as to cause almost complete cessation of growth. Emaciation is at times severe in cases of pyloric obstruction.

Bleeding is present, to some extent, in about 40 per cent of the cases. It varies from blood streaks in the vomitus, or traces in the stool, to profuse hæmorrhage. As much as a quart of blood has been reported to have been vomited, or it may appear only as melæna. There may be a slow, chronic loss of blood, with no symptoms except pallor.

Perforation occurs in about 25 per cent of the cases. The symptoms of ulcer have usually been present from one to several years, but the child is not brought for examination until perforation has occurred. General peritonitis is almost always present, and the mortality has been about 50 per cent. The high incidence of perforation and bleeding in the cases reported is unquestionably due to the fact that most cases are unrecognized, and unless one of these complications, or a stenosis of the pylorus with vomiting is present, the condition is, as a rule, not diagnosed.

DIAGNOSIS

The most important single factor in the diagnosis is the realization that chronic peptic ulcer occurs in children. It is found least often in early years, and occurs with gradually increasing frequency until the limits of childhood are passed. Chronic or recurring attacks of dyspepsia in a child should lead one at least to consider the possibility of peptic ulcer. Particularly is this true if the growth is retarded, or if the child is underweight, or pale.

Hyperchlorhydria is absent usually; when present it may be helpful in diagnosis. Blood may be found in the gastric contents, or in the stools, especially on repeated examination.

The X-ray is of great assistance in the diagnosis. The gastric ulcer is plainly evident on the lesser curvature in Case 1 (Fig. 5). In Case 2 a pyloric obstruction was revealed. Even among roentgenologists of wide experience, few will make a definite diagnosis of peptic ulcer, but the fact that a lesion is present will usually be noted. In but few of the reported cases was an X-ray examination made, but there is reason to believe that the findings are similar to those in the adult. The motility of the stomach is greater in children.

TREATMENT

Medical treatment should always have a thorough trial, unless there are definite contraindications, such as marked stenosis at the pylorus, repeated hæmorrhages, or perforation. Particularly in cases with a short history, there should be no more favorable conditions under which to try medical treatment for peptic ulcer. The regenerative powers of a child, as is well known, are much greater than those of the adult, and constitute a most powerful factor in favor of cure. The management may be essentially the same as in the adult, with modifications when necessary. It would be very hard, for example, to keep the younger children quiet. The younger the child, the more prompt the response to treatment.

If medical treatment fails, or if there is stenosis, repeated hæmorrhage, or perforation, the case becomes surgical. The simplest operations are best. In the case of a gastric ulcer, it is probably wisest to excise it, and to perform a pyloroplasty or gastro-enterostomy. One does not have to be concerned over the possibility of the ulcer being malignant, or becoming so, during childhood.

For duodenal ulcer, a simple excision, or excision and pyloroplasty, after the method of

Judd or C. H. Mayo, is undoubtedly best. It is the simplest procedure, and involves the least disturbance of the anatomy. If this is impossible or inadvisable, particularly in cases of marked stenosis of the pylorus, a gastroenterostomy may be safely done, or even a partial resection, should conditions demand it.

In fact, it would appear that one may do as much surgery on the stomach in children as in adults, with little or no more risk. This would probably not include infants and very young children. The power to withstand shock seems good, and the rapidity and vigor of the reparative processes are great. Theile reports the case of a 2-year old child, in which de Quervain did a resection of the pyloric end of the stomach, with uneventful recovery.

DISCUSSION

Just what is the incidence of chronic peptic ulcer in children? Is it as rare as one would be led to believe from the cases found in the literature? Adult patients often say that they have had symptoms all their lives. Various writers have reported cases in which the symptoms dated back to childhood, and have even reported them as cases in children. To throw some light on this question, I determined from the records of the last 1,000 gastric ulcers, and from the last 1,000 duodenal ulcers seen at the Mayo Clinic, what percentage of the patients had symptoms in childhood. Sixteen of the patients with gastric ulcer had symptoms dating back to childhood, even to the age of 4 or 5 years, and 26 of those with duodenal ulcer. Thus, 42 patients from a total of 2,000 with peptic ulcer, or 21 for every thousand, had the onset of their disease as children, and often the condition dated back many years into childhood. These data leave little doubt but that the disease is often unrecognized in children, and that if the possibility of the condition is borne in mind, there will be a steadily increasing number of cases diagnosed, and chronic peptic ulcer in children will cease to be a rarity.

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AN UNUSUAL EXPERIENCE WITH NEPHRECTOMY FOR SUPPURATIVE NEPHRITIS

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I HAVE been reminded of a case of acute suppurative nephritis that came under my observation 10 years ago, by the article of Cunningham and Graves, in the July number of Surgery, Gynecology and Obstetrics, 1924, xxxix, 39. The case presents some unusual features with regard to its etiology and corresponds in this respect to another case that I published in an article on unilateral hæmatogenous infection of the kidneys, in the Festschrift for the fortieth anniversary of the German Hospital, now the Lenox Hill Hospital of New York City, in 1909, page 229.

In that communication I reported 4 cases and drew attention to the fact that the right kidney was more frequently involved than the left, and that the far greater number of these patients were women. The cases at that time at my disposal were those that had been reported by Brewer[1] and by Cobb[2] which, with my own, amounted to 28 cases. Of these, 24 were in women, the right kidney being involved 21, and the left 3 times. Of the 21 right kidneys, 2 had shown previous physical defects, leaving 19 cases in which, to all appearances, the infection had occurred in a healthy kidney. As 2 of my 4 patients had movable kidneys, I concluded that the latter, in their exposed position, were more easily affected by even slight traumata (contusion) than a kidney lying well under the costal border, and were, in consequence, more liable to hæmatogenous infection.

In the literature of the subject I had found mention of the fact that violent contraction of the abdominal muscles and muscles of the back could produce lesions in the kidneys. Such lesions can be followed by a unilateral hæmatogenous infection. This happened in the case of one of my patients, previously reported, a young man, who, while lifting a heavy load, felt a sudden, severe pain in the left side, which was followed by the development of a suppurative nephritis. In the following instance violent muscular contraction, no doubt, was also responsible for some lesion to the kidney, which led to hæmatogenous infection.

Mrs. C., 62 years of age, had had a cholecystectomy for gall stones some years ago; otherwise she never had any serious illness. On July 4, 1914, while ascending the steps of her cottage she slipped and, in attempting to prevent a fall, she suddenly felt a very severe pain in the region of the left kidney, which caused her to sink to the ground. She distinctly states that the pain came on while she was still on her feet. She had great difficulty in rising and walking into her house. She went to bed and remained there until I saw her on July 9, when her temperature in the mouth was 103.5 degrees, pulse 110. She presented other symptoms of septic intoxication, abdomen slightly distended, region of the left kidney very tender to touch, kidney apparently slightly enlarged. Nothing could be made out on the right side in the way of pain or swelling of the kidney. The patient was removed to the hospital on July 11 in a very serious condition. There was no opportunity of making functional tests of the kidneys. The urine contained many pus cells, but no organisms were identified. On July 12, 8 days after the accident, I exposed the left kidney through a lumbar incision. The organ was somewhat enlarged. After the capsule had been stripped off and removed, the cortex appeared to be densely studded with miliary abscesses (see illustration). Nephrectomy was done. On the afternoon of the day of operation we had the usual drop of temperature, in this instance from 104.4 to 97.6 degrees. The patient seemed to be doing well during the next few days, although the temperature gradually rose to 101.8 degrees on the evening of the second day. It fell to 99 degrees on the fourth, continuing at this level until death occurred on the eighth day from renal insufficiency.

The autopsy revealed a suppurative nephritis also on the right side. I quote from the pathologist's report: "The surface of the right kidney in general is more evenly congested than that of the opposite side and the mottling is finer. Scattered over the surface are found numerous small grayish points, resembling miliary abscesses. These are not nearly as abundant as in the left kidney, removed at operation, and show a far greater variation in size and irregularity of distribution. The majority are small, averaging about 1 millimeter. But in addition to these there are found several patches a centimeter in diameter formed by conglomerated smaller ab-

[1] Surg., Gynec. & Obst., 1906, ii, 485.
[2] Ann. Surg., 1908, xlviii, 680.

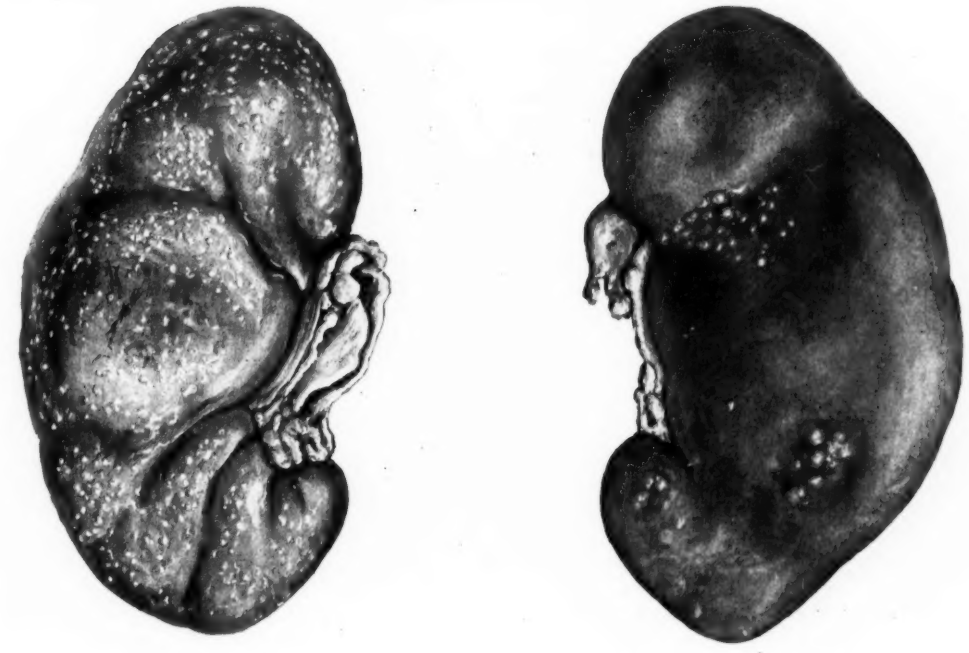

Fig. 1. Drawing showing at left, the right kidney, and at right, the left kidney.

scesses. On section the cortex is slightly less swollen than that of the left kidney, the markings are finer and the miliary abscesses are not as abundant. In the medulla they seem more abundant than on the left side.

"Cultures were obtained (1) from urine a few days after operation; (2) from the left kidney immediately following nephrectomy; and (3) from the right kidney at autopsy. All showed the same organism in pure culture, bacillus coli communis."

This is a case that has practically the value of an experiment on the living human being. The patient, who had never suffered from any disease of the genito-urinary tract and in whom the autopsy revealed no pathological condition in the kidneys of old standing, developed what at first probably was a unilateral hæmatogenous infection on the left side, following a trauma. During her illness nothing pointed to an involvement of the right kidney. Although the pathologist's report speaks of a greater number of miliary abscesses in the medulla of the right kidney, the general impression gained from a comparison of the two kidneys (see illustration) is that the left is further advanced in disease than the right. Had the affection started simultaneously in both organs the disease would scarcely have made greater progress in a week on the left, than in 2 weeks on the right side.

Cunningham and Graves distinguish between two types of hæmatogenous infection, the suppurative and the non-suppurative, diffuse inflammatory. "These types should be recognized upon inspection at the time of operation, as they require different treatment." This is very true and generally, I think, not very difficult. It is a more difficult task to decide upon the course to pursue in a given case of the acute suppurative variety after the kidney has been exposed and inspected. While the streptococcus and staphylococcus infections generally demand nephrectomy to overcome profound septic intoxication, a colon

bacillus infection may present an equally urgent clinical picture, as my case demonstrates. That a unilateral streptococcus, on the other hand, if not surgically treated at the outset, can lead to abscess formation, perforation of the capsule of the kidney and to a perinephritic abscess without fatal issue, is shown by the history of the case previously mentioned, in which infection also followed violent muscular exertion. The perinephritic abscess in that case was incised at the end of the second week. About a week later the kidney had to be removed, as the septic condition was not relieved. Following nephrectomy the patient developed a streptococcus septicæmia. He was in the hospital for 1½ years with numerous metastatic abscesses, including suppuration of the left hip joint. In all of the latter, streptococci in long chains were found and blood cultures, frequently taken, showed the same micro-organism. The remaining kidney was never involved. The patient finally recovered.

In the first case (Mrs. C.) I regard the invasion of the right kidney by the colon bacillus as not occurring simultaneously with invasion of the left, for I do not see why the process should develop at the same time in both kidneys, when the lesion on the left side was distinctly traumatic in origin. In none of my other cases did any symptoms develop after nephrectomy that could have been referred to the remaining kidney. Nor do I remember any report in the literature of the subject of a fatal issue because the second kidney also became the seat of a suppurative nephritis, but this may be due to my inability at present to make a careful survey of the literature. Perhaps also, in this instance as in many others, successful cases are more apt to find their way into surgical literature than unsuccessful ones. I have often wondered whether the removal of the left kidney could be held responsible, in part at least, for the later involvement of the organ on the right side. A kidney that has ceased functioning can, of course, be removed without any untoward effect on the other kidney, save such as may follow any operative interference. Generally, in the early stages of suppurative nephritis, functional tests show somewhat retarded elimination on the diseased side, when the urine otherwise may show little change either macroscopically or microscopically. I do not believe that the function of such a kidney has been seriously impaired when the patient has only been ill for a short time (in my case the accident leading to infection occurred 7½ days before nephrectomy was done). The removal of such an organ should have a different effect on the remaining kidney than the removal of a simple pus sac without function, and I can appreciate that it might act, indirectly, as a trauma, favoring the retention of germs still circulating in the blood, and thus producing a secondary infection on the other side.

In removing the kidney I certainly deprived my patient of the only chance of recovery that she had. I do not mean to say that she would have recovered after one of the minor operations (decapsulation or nephrotomy), but I cannot exclude the possibility. The case only shows the difficulty of deciding at operation from the appearance of the organ after decapsulation what to do, especially when no definite knowledge of the nature of the infection is at hand and when the other kidney is to all appearances sound. I have suggested in these cases decapsulation and packing of the wound cavity around the kidney, which might be followed by a rapid nephrectomy if decapsulation alone produced no improvement. I did not follow my suggestion in this case because I considered the patient's condition too serious and had no reason to suspect an involvement of the other kidney, existing at the time of operation or coming on later. The case is another argument in favor of conservatism, by which I mean early exploratory operation with decapsulation, even if inspection of the kidney should occasionally disclose a faulty diagnosis. Nephrectomy should be added only if urgent symptoms of septic intoxication persist, with the thought in mind that the latter, even in apparently extreme cases of unilateral infection, will generally subside after removal of the kidney.

SEPARATION OF THE ACROMIOCLAVICULAR JOINT[1]

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THE treatment of separation of the acromioclavicular joint has as a rule been conservative, that is, by strapping and rest. In several cases seen recently by the writer the end-result by this method has been so poor that operative measures seemed indicated.

The lesion varies from stretching of the ligaments binding these two bones together allowing abnormal play in this joint, to rupture of the joint. From a mechanical point of view, it would seem that strapping would be inadequate. The extended arm raised in abduction is a lever of the third class, the power being the contraction of the deltoid which is inserted close to the fulcrum. The mechanical advantage of this muscle in respect to the location of its origin and insertion is also slight. It arises for the most part from the upper portion of the scapula. The scapula in turn is steadied by the action of the clavicle as a strut.

From these considerations it may be seen that the force exerted through the acromioclavicular joint in the action of raising the arm must be considerable, and from a purely mechanical standpoint it does not seem logical to suppose that stretched or ruptured ligaments will sufficiently bind the bones of this joint to allow function. There would seem to be a doubt of the efficacy in taking up the strain of strapping applied outside the skin and the bulk of the deltoid muscle.

The type of union sought for would be a fibrous union which would hold the bones firmly in contact and still allow the play necessary in this joint in raising the arm above a right angle. For this reason it will be seen that bony ankylosis is undesirable. Undoubtedly under treatment by strapping there usually occurs, in a great number of cases, contraction of the shoulder muscles anchoring the scapula so that the arm may be abducted by rotation of the scapula only. Such a result seems mechanically imperfect.

Of the following cases 2 had been treated for months by strapping with very poor result. One of these 2 patients submitted to operation and regained full motion. The other refused operation. Of the remaining 6, 5 were treated by curettage and fibrous union resulted, and 1 was treated by insertion of a beef bone screw. Of the 5, 4 have normal function as a result. The other was lost before his after-care was completed but when last seen had a stable joint, and abduction was limited only by weakness of the muscles. In the case in which the beef bone screw was used, there resulted abduction slightly beyond a right angle but the immobility of this joint checks the upper range.

Case 1. V. V., age 40, was admitted to the Orthopedic Service of Ann May Hospital, Spring Lake, New Jersey, May 28, 1923, following an automobile accident, in which the patient was thrown violently against the steering wheel.

Local examination. The patient was unable to abduct the arm beyond 40 degrees and this movement was accompanied by much pain in the shoulder. The outer end of the clavicle was prominent. June 4, the joint was exposed and the articulating surfaces curetted. The clavicle was sewed to the acromion by double strands of chromic catgut through the periosteum of both bones. The arm was put up in a plaster spica with 90 degrees abduction. On June 25, the plaster was removed from the arm. Passive motion and massage were started. Patient was discharged from the hospital with directions to keep the arm elevated as far as possible. October 10, function was normal.

Case 2. M. S., age 35, June 14, 1923, was admitted to the Orthopedic Service of the Ann May Hospital. Alighting from a car the patient was struck by an automobile. The local condition was as in the previous case. June 19, the acromioclavicular joint was exposed. The articulating surfaces were curetted, and a beef bone screw was inserted through the acromion into the clavicular head. The after-care was like that in the previous case. November 10, 1923, the patient could abduct the arm to 90 degrees only, there being apparently a bony ankylosis at the joint.

Case 3. G. D., age 30, was referred for complaint of inability to raise arm, February 6, 1924. The onset followed a strain while at work lifting heavy lumber.

Local examination. The patient could abduct the arm about 30 degrees, in a plane 45 degrees anterior to the lateral. This is accompanied by rotation of the scapula. February 20, curettage and sewing of joint was done. At present time pa-

[1] Read before the Clinical Conference, Hospital for Ruptured and Crippled, July, 1924.

tient can abduct the arm to about 100 degrees without rotation of the scapula, and passive motion beyond this joint shows that there is no bony ankylosis of the joint.

CASE 4. C. G., age 60, was referred on complaint of inability to raise the arm. March 20, 1924, the patient fell on the point of the shoulder. March 28, operation was done as in the previous cases. At the present time the patient can abduct the arm through its normal range without difficulty, the scapula starting to rotate at 90 degrees.

CASE 5. T. S., age 28, was admitted to Orthopedic Service, Monmouth Memorial Hospital, Long Branch, New Jersey, unable to raise the arm. April 24, 1924, attempted abduction was accompanied by rotation of the scapula. Previous to operation the clavicle became locked to the acromion by overriding when it was possible to abduct the arm to 100 degrees by rotation of the scapula. With overriding corrected the range became limited to 30 degrees. The same operation was performed as in previous cases, but at the time of discharge full function had not returned although there was firm fibrous ankylosis in the joint.

CASE 6. W. F., age 32, was admitted to the Hospital for Ruptured and Crippled with complaint of inability to raise the arm 3 weeks after an automobile accident. An operation similar to that done in the previous cases was performed and normal function returned.

CASE 7. M. B., age 40, was seen in consultation April 10. Operation was refused. Three months previously the patient was shaken up in an automobile collision. The patient had pain in the shoulder and was unable to raise the arm. The case had been followed by X-ray and showed increasing overriding of the two bones entering into the joint. At the time of my examination there was contraction of the shoulder muscles so that abduction of the arm was possible to about 30 degrees only and was accomplished by rotation of the scapula. The patient had been treated by strapping but refused operation because her condition had been much worse immediately following the accident.

CASE 8. A. J., age 25 (seen with Dr. O. R. Holters through whose courtesy the case is reported), was admitted to Monmouth Memorial Hospital, June 23, 1924, with a complaint of inability to raise the right arm. The patient fell a week ago striking on the right shoulder.

Local examination showed swelling, discoloration and extreme tenderness over the right acromioclavicular joint. Abduction was painful and limited to 50 degrees. Operation June 24, 1924, consisted of curettage and suture of joint. The after-care was like that used in previous cases. Normal function had been regained when seen on August 26, 1924.

CONCLUSIONS

1. Strapping is mechanically inadequate to restore function of joint in all cases.

2. The operation of choice is curettage and suture of the two bones resulting in fibrous ankylosis.

3. The use of internal fixation leading to bony ankylosis of this joint is undesirable.

IS DISEASE OF THE GALL BLADDER A CAUSE OF DIABETES MELLITUS?[1]

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SEVERAL factors may contribute to the precipitation of diabetes mellitus, but its true cause is unknown. Disease of the gall bladder in middle-aged and elderly persons has been given considerable prominence as an etiological factor, certain observers believing it to be significantly associated with diabetes mellitus. It is possible that infection in the gall bladder produces pancreatitis, and finally changes in the islands of Langerhans with resulting diabetes.

Rolleston believes that diabetes does not favor the production of gall stones, but on the other hand, that cholelithiasis may indirectly produce diabetes (pancreatic).

Rabinowitch has determined the actual incidence of diabetes and of disease of the gall bladder in hospitalized patients, and has compared these data with the incidence of the two diseases on the basis of probability. His findings appear to show that the actual occurrence of the two diseases is considerably greater than is indicated by the calculation of the probability. Eustis, O'Day, Carr, Hedinger, Dufourt, Hochhaus, and others have reported cases which seemed to show a significant association between the two diseases.

Lichty and Wood, on the other hand, in a statistical study, conclude that the case against the gall bladder as a causative factor in the precipitation of diabetes is not entirely proved.

For the purpose of further investigation of the subject, I studied the records of a group of patients with disease of the gall bladder and diabetes mellitus who had been observed in the Mayo Clinic during a 4-year period (1920 to 1923 inclusive). Only the records of patients 40 years of age or more were considered, and none was included if the diagnosis, either of disease of the gall bladder or of diabetes, was doubtful. During this period 6,500 patients with disease of the gall bladder were seen at the Clinic. This number is as accurate as the case records of any large group of patients will allow. It includes both medical and surgical cases, and is made up almost without exception of cases of cholecystitis with and without stones. There were 1,101 patients, aged 40 years or more, with true diabetes at the Mayo Clinic during the same period; these do not include patients with simple glycosuria, or those showing inconstant glycosuria when they were not on a restricted diet. One hundred thirty-eight patients had both disease of the gall bladder and diabetes. According to these data, therefore, 1 of 47 patients, 40 years of age or more, with disease of the gall bladder has diabetes, and 1 of 8 patients with diabetes, 40 years of age or more, has disease of the gall bladder.

The patients who suffered from both diseases were divided into medical and surgical groups, and questionnaires were sent to the 138 patients. Ninety-two answers were received. Eighty-nine per cent of the patients had had symptoms of disease of the gall bladder before they had symptoms of diabetes, and 11 per cent had symptoms of diabetes first (Table I). As already stated, one patient in 47 (2.1 per cent) with disease of the gall bladder has diabetes. From these two facts, a third can be deduced: that 89 per cent of 2.1 per cent, or 19 out of every 1,000 patients who have disease of the gall bladder will later develop diabetes. Of course, on the other hand, 981 will escape.

Another point was whether or not the removal or drainage of an infected gall bladder improved an existing diabetes. The percentages of patients who were improved, based on the answers to the questionnaires, appears to be about the same in 25 cases in which operation was not performed as in those in which it was. In 20 per cent of the surgical cases, and in 25 per cent of the medical ones, there was evidence of definite improvement in the diabetes (Table II).

[1] Submitted for publication January 4, 1924.

TABLE I.—ONSET OF SYMPTOMS

	Medical		Cholecystitis		Cholelithiasis	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Disease of the gall bladder preceding diabetes	41	55.4	10	62.5	22	45.8
Diabetes preceding disease of the gall bladder	7	9.5	1	6.2	8	16.6
Simultaneous onset of symptoms of gall bladder disease and diabetes	3	4.0	0		0	
No symptoms of disease of the gall bladder	4*	5.4	0		1	2.1
Time of onset of diabetes doubtful	12	16.2	3	18.8	15	31.3
Time of onset of disease of the gall bladder doubtful	5	6.8	2	12.5	0	
Time of onset of both diseases doubtful	2	2.7	0		2	4.2

* In two of these cases stones were found during pelvic operations, and in one during necropsy. One patient had severe gall-bladder attacks after leaving the Clinic.

TABLE II.—EFFECT OF TREATMENT[1]

	Medical		Cholecystitis		Cholelithiasis	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
With no change in tolerance	21	65.6	7	53.8	24	75.0
With increase in tolerance	8	25.0	3	23.1	6	18.7
With decrease in tolerance	3	9.4	2	15.4	2	6.3
With change in tolerance doubtful	0		1	7.7	0	

[1] Percentages based on patients living at present time.

With reference to tolerance for glucose, the medical and surgical cases are probably comparable. It might be argued that in the medical cases symptoms referable to the gall bladder were not pronounced, or else operation would have been performed. This hardly holds true because frequently when surgical treatment was advised, the patient refused it. Moreover, in the surgical cases, a gall bladder was occasionally found that was only moderately diseased. It is sometimes difficult to determine whether patients with diabetes, 40 years of age or more, improve permanently. No patient was considered improved unless there was definite evidence of a permanent increase in tolerance for glucose. For example, if when a patient left the hospital he was capable of keeping his urine sugar-free only on a diet with a low or moderate glucose value, and 2 or 3 years later, was still aglycosuric on a diet considerably richer in glucose, this was considered as indicative of improvement in tolerance.

Almost without exception, all patients, whether they had received medical or surgical treatment, attended the lectures given to patients with diabetes at the Clinic, so that they were well trained to care for themselves after they were dismissed from observation. The prolonged careful régime carried on by the patient probably accounts, in part, for the increase in tolerance observed in some cases. Obesity was a factor in certain cases, and reduction of weight probably brought about improvement in the diabetes.

The cases of diabetes in this study were classified into the following groups: (1) acute, progressive, (2) obese, (3) vascular, and (4) doubtful (Table III).

TABLE III.—TYPES OF DIABETES

	Medical		Cholecystitis		Cholelithiasis	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Obese	46	62.2	5	31.2	34	70.8
Vascular	16	21.6	6	37.5	6	12.5
Obese and vascular	3	4.0	1	6.3	0	....
Acute progressive	2	2.7	1	6.3	1	2.1
Doubtful	7	9.5	3	18.7	7	14.6

In Group 1 are included cases of acute, progressive diabetes in which the cardinal symptoms developed suddenly, with a tendency toward rapid loss of weight, strength, and tolerance.

In Group 2, the patients were considerably overweight, and the onset of the cardinal symptoms of diabetes was gradual.

In Group 3 there was definite evidence of arteriosclerosis and also a gradual onset of the symptoms of diabetes.

In Group 4 there was no obesity, and no evidence of arteriosclerosis; the diabetes was mild and the onset of symptoms gradual.

It is worthy of note that in 70 per cent of the proved cases of cholelithiasis the patients were obese, whereas in only 31 per cent of the proved cases of cholecystitis the patients were obese.

Symptoms of disease of the gall bladder usually develop at the age of about 42 years, and no signs of diabetes appear until about 50. This statement is based on an average of the ages in the medical and surgical cases (Table IV).

TABLE IV.—AGE

	Medical			Cholecystitis			Cholelithiasis		
	Cases	Per cent	Average age, years	Cases	Per cent	Average age, years	Cases	Per cent	Average age, years
Total number	74	53.6	53	16	11.6	53	48	34.8	54
Average age at onset of disease of gall bladder			40			45			44
Average age of onset of diabetes			49			50			52

Grand average age at onset of gall bladder symptoms, 42 years.
Grand average age at onset of diabetes, 50 years.

Sixteen patients (11 per cent) had symptoms of diabetes preceding any manifestation of disease of the gall bladder. It is true that a gall bladder harboring infection, but giving no evidence of it, might have been present for some time, but it is probable, in a few cases, at least, that the diabetes actually preceded disease of the gall bladder. Table IV gives the various data relative to the time of onset of the two diseases.

It is likely, in many cases, that by the time a patient with a diseased gall bladder comes to operation, the liver and pancreas are probably already permanently damaged. The extirpation of the gall bladder may remove a source of continuous irritation, but, in all probability, no regeneration of parenchymal tissue or improvement of hepatic and pancreatic function can be demonstrated.

Apparently, the duration of the gall bladder symptoms has no relation to the degree of severity of the diabetes, because, of the whole group comprising this series, only 4 patients had acute progressive diabetes, the form of the disease in which the maximal severity is to be expected. The patients who had symptoms referable to the gall bladder for a long period were not those who had the severe type of diabetes.

The data used in this study are based almost wholly on the findings at the bedside, in the laboratory of surgical pathology, and in the operating room. They are therefore open to a greater error than if they were based on data obtained at necropsy. Mentzer has shown, for example, that about 80 per cent of the tissues examined after death, of persons more than 40 years of age, have signs of inflammation in the gall bladder. In such event, if diabetes were a usual outcome of cholecystitis, one would expect the incidence of diabetes in the population at large to be higher. Probably the true answer will not be known until it has been definitely proved that cholecystitis usually causes some inflammatory change in the acinar tissue of the pancreas, and that pancreatitis is usually accompanied by changes in the islands of Langerhans. This is a difficult point to prove, and would require a close study of the entire pancreas in a large series of cases.

It is well known that an infectious process has a pernicious effect on a co-existing diabetes, and that the disappearance of such infection brings about improvement in glucose tolerance. The removal of any localized infection, whether it is in the gall bladder, kidney, or tonsil, may diminish the severity of a co-existing diabetes. It seems hardly justifiable, therefore, to expect more improvement following the removal of an infected gall bladder than following the removal of any localized infection, simply because the gall bladder happens to be the close neighbor of the pancreas. It is quite likely that an infected gall bladder of itself does not cause diabetes mellitus, by first producing pancreatitis, or by some other mechanism. It may be, however, that the infected gall bladder is one of several contributing factors. Often persons 40 years of age or more are obese, and usually have some arteriosclerosis;

these factors, plus an infected gall bladder, may suffice to throw the balance in favor of a mild diabetes. Two men may not be able to lift a weight, but, with the help of a third man, the weight may be lifted. Possibly a diseased gall bladder is in the position of the third man in cases of diabetes.

It should be mentioned that in this series of cases surgery was not necessarily attempted with the idea of diminishing the co-existing diabetes, but because of the gall bladder per se; this is a constant policy in the Mayo Clinic in deciding whether a patient should or should not undergo an operation. If the symptoms of disease of the gall bladder are of themselves sufficient to warrant operation, it is advised. With the decreased mortality following operation in cases of diabetes (10) there has been no hesitation in submitting patients with diabetes to operation.

CONCLUSIONS

1. Disease of the gall bladder is a doubtful factor in the causation of diabetes mellitus. With associated obesity or arteriosclerosis, or both, it may play a part.

2. Our statistical evidence does not support the view that the removal of a diseased gall bladder will favorably influence co-existing diabetes.

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CHEMOTHERAPY WITH RIVANOL

2 AETHOXY—6.9 DIAMINO-ACRIDINE[1]

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THE EVOLUTION OF CHEMOTHERAPY

CHEMOTHERAPY, as conceived by Ehrlich, implied a systematic search for chemical substances with a strong affinity for parasites, and a weak or possibly no affinity for the cells of the host. The relation of the "parasitotropic" and "organotropic" qualities of a drug to each other is the therapeutic index of that drug. The great number of efficient substances that have been synthesized by Ehrlich and his coworkers indicate the fruitfulness of this simple diagrammatic theory. Results in trypanosomal and spirochætal infections have been of the greatest value, and have stimulated further investigation. Yet more and more facts have presented themselves, which could hardly be explained by an effect on the parasite alone. The participation of the host, disregarded in Ehrlich's original conception, seemed to gain in importance. As emphasized by Dale in his review of chemotherapy (19), the original conception of Ehrlich, although vital to the evolution of chemotherapy, has served its purpose and is now regarded merely as an excellent working hypothesis.

One of Ehrlich's coworkers, Morgenroth (47), developed Ehrlich's idea further. Parasitotropy and organotropy are no longer regarded as opposites; on the contrary, the affinity of a drug for the cells of the host acts as a link which enables the antiseptic to attack the parasite. It was suggested that quinine acted on malarial plasmodia because of its demonstrable storage in the erythrocytes, and the same statement was made with regard to Morgenroth's new acridine derivative, rivanol (52). In this process of depot-formation and gradual liberation of the active substance, Dale sees a widespread importance for chemotherapeutic action. The phenomenon by which a substance passes from one medium to another, both having strong affinities for it, is called transgression by Morgenroth. Phenomena of acquired resistance, specific for the infected host as well as for the infecting strain, show that the co-operation of the host must be regarded as more active.

In experiments of Dale and Dobell, a strain of entamœba, which was susceptible to treatment by emetin in the human patient, was completely resistant to emetin in kittens, to which it had been transferred before the beginning of the treatment. The immune reaction of the host in the chemotherapy of pneumococcal infection with optochin, was emphasized by Neufeld and Engwer, Engwer, and Moore. The last named showed that the combined effect of optochin and antipneumococcal serum was about fifty times greater than a summation of the two effects. When the antiserum was used against a group other than that to which the infecting pneumococcus belonged, no result was obtained. That the effect of a chemical agent on septicæmia is not a direct disinfection is further demonstrated by the observations of Felton and Dougherty (27). These authors found an optimal dose of optochin for the prevention of septicæmia, with simultaneous injection of multiples of the lethally infecting dose of pneumococci. On increasing the dose of optochin beyond this optimum, but still below the host's tolerance, the same number of pneumococci produced a fatal septicæmia. As Dale points out, the higher dose suppresses the defensive reaction of the host, and the simple antibacterial action is inadequate without the reinforcement. Using urotropin intravenously for generalized infection, I tried to explain its action as a stimulating effect on the defensive reaction of the patient (70). A simple antibacterial action, as shown *in vitro* by Buzello, would require 115 grams instead of 4 grams daily.

All these observations point conclusively to an active participation of the host in any attempt at antisepsis. Whether this is a non-

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specific "healing inflammation" or a specific immune reaction produced by chemical antisepsis, cannot be decided. In connection with local injections of antiseptic agents, questions of alkalinity of the tissues, adsorption and absorption of the injected drug, will arise; these will be discussed later.

THE VALUE OF EXPERIMENTAL INFECTIONS IN CHEMOTHERAPY

If the defensive reaction of the host plays such an important part in chemotherapy, the test-tube experiment cannot be of decided value in determining how the drug is going to act *in vivo*. It has long been known (5) that most antiseptics enter into combination with the proteins of the body, and their efficacy is thus greatly reduced. Therefore serum (65, 66), and even pus from human infections (15, 39), were used to suspend organisms, and antisepsis tests were carried out in these media. Even these conditions are extremely simple as compared with those in the living tissue. Brunner, von Gonzenbach, and Ritter, and Braun and Goldschmidt produced fatal anaerobic infections in guinea pigs with minimal quantities of highly pathogenic earth samples (0.05 gram) that were sewed in pockets under the skin. As the untreated control animal always died from tetanus or malignant œdema, the value of different antiseptics in different concentrations, combined with mechanical antisepsis and open treatment, could be estimated in exceedingly clear-cut experiments.

Neufeld (55) experimented with various acridine dyes with regard to their value in pneumococcus and chicken-cholera infections. Feiler, using the method of Braun, rubbed diphtheria strains into superficial wounds, and tested out trypaflavine by this method. Reinhardt made the very significant observation that trypaflavine (1:100) had a marked neutralizing effect on diphtheritic toxin, and not merely a bactericidal action. Morgenroth (47, 48, 49, 51, 53) succeeded in producing slowly progressing infections in mice with avirulent strains of streptococci and staphylococci obtained from pyogenic infections in man, and injected in animals without being carried through animal passage. Those animals which were not treated died from generalized sepsis, whereas those which received local infiltrations with rivanol were saved. The bacteria were killed off in the tissues, as proved by cultures taken at various intervals. At the same time the reaction of the normal living tissue to various concentrations could be studied histologically.

Axhausen uses the sensitive cartilaginous cover of the knee-joint of the rabbit to test out the effect of antiseptics on normal living tissue. Odermatt found marked vasoconstriction on the ear arteries of rabbits after the use of locally injected cinchona derivatives (eucupin, vuzin, optochin). Rivanol acted in a similar way. In a recent, extensive, experimental and clinical study of the two acridine dyes, trypaflavine and rivanol, Brunner and von Gonzenbach give a complete review of this and of other experimental work along this line. Comprehensive bibliography may be found in their article.

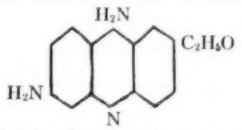
That animal experiments allow a more close and appropriate study of antiseptic agents than does the test tube is evident. Their value in relation to clinical experience will be discussed later.

THE ACRIDINE GROUP

The use of dyes in antisepsis originated in Ehrlich's vital stain studies. As early as 1891 he published some observations with Guttmann in which methylene blue, which stained the malarial parasite, was selected as an agent that might possibly cure malaria. Later Ehrlich with Shiga produced and used a great number of various dyes. It is curious to follow the evolution of this dye antisepsis up to the present time, and see how a drug, selected for its evident fixation by the protoplasm, slowly loses its dye character as already manifested in rivanol in contrast to trypaflavine. This characteristic is most striking in Bayer 205, a colorless non-dyeing fluid, with a most elective curative effect on certain types of trypanosomiasis. The best known acridine dye, trypaflavine, was synthesized in 1912 by Benda, used by Ehrlich because of its trypanocidal action, and studied extensively in England by Browning and his coworkers, who found it to have a powerful bactericidal action that was

not inhibited, but augmented by serum, with little toxicity for the host and hardly any depressant effect on its leucocytes. Besides trypaflavine (or acriflavine) certain other derivatives of this group, such as flavine and acridine orange, have been used by Neufeld in the treatment of chicken cholera produced experimentally. Smith has used various acridine compounds in experimental tuberculosis of animals with negative results, and quite recently Lewis tested out a series of these dyes, synthesized by Jacobs, and found that the ripening of the oocyst of coccidia in rabbits is prevented by acridine hydrochloride.

Morgenroth (49), after having suggested quinine derivatives (eucupin and vuzin) for local infiltration antisepsis, recognized in a systematic search of various cinchona and acridine derivatives, the antiseptic value of a member of this latter group: 2 aethoxy—6.9 diamino-acridine, known commercially as rivanol. The construction of this dye was given as:



and the soluble hydrochlorate was used. Morgenroth's description of this drug is as follows: a light yellow, fine crystalline powder, soluble in approximately 260 parts of water at 25 degrees C. and 28 parts of hot water. The solutions are yellow and fluorescent, but darken when exposed to light for several days, and may show a slightly brown precipitate. The aqueous solution is stable to boiling; the reaction to litmus is neutral.

Morgenroth determined the antiseptic power of rivanol in living tissue. A dilution of 1:40,000 sterilized an experimental streptococcus which showed phlegmon in the subcutaneous tissue of the mouse within 24 hours. These results were obtained with more than 40 different strains. In the test tube streptococci were destroyed in the presence of serum by a concentration of 1:100,000, this giving the favorable antiseptic index[1] of $\frac{40,000}{100,000} = \frac{1}{2.5}$. In staphylococcic infections the index was greater than 1. Although trypaflavine was shown to be more efficient in the test tube, rivanol was more effective in the subcutaneous tissue of the mouse, showing the value of the biological tests. Solutions of 1: 1,000 and 1:500 are well tolerated in the subcutaneous tissues of mice and horses, and do not cause any injurious effects. More concentrated solutions cause infiltration. The lethal dose for the rabbit is 100 milligrams for each kilogram of body weight, if given subcutaneously, and 50 milligrams if given intravenously. This slight toxicity permits the use of a large amount of the diluted concentrations in man, and favors its use in powder form to a much greater extent than trypaflavine does, the latter being much more toxic.

[1] The absolute antiseptic index (47) is a ratio between the antiseptic concentration of a drug *in vivo* and *in vitro*, the ideal index being 1/1, when the action of the drug in the living tissue is not inhibited in comparison with that in the test tube.

TISSUE ANTISEPSIS

On this experimental basis, a local tissue antisepsis was suggested, and rivanol recommended for clinical use. Since the first appearance of this dye in 1921, a large number of articles have appeared on this subject. It must be emphasized that trypaflavine and rivanol are the only known substances which, in spite of a very strong affinity for certain pathogenic bacteria, such as streptococci and diphtheria bacilli, do not cause any tissue necrosis or infiltration, and that the attack on localized infections by local tissue antisepsis is utterly different from the intravenous treatment of localized foci with beginning generalization. While the intravenous use in combination with antistreptococcic serum (50 to 100 cubic centimeters of 1:1,000 solution of rivanol plus 50 cubic centimeters of antistreptococcic serum) is advised by noted clinicians, such as Bumm and Sigwart, in puerperal sepsis, and is used in the form of intramuscular injections of from 150 to 200 cubic centimeters of a 1:500 solution in generalized sepsis by Rosenstein, the main significance of its use, in my opinion, lies in the possibility of a local infiltrative method that has hitherto not been possible with our other strongly caustic and protein precipitating antiseptics. As is the case with local anæsthetics, the locally injected antiseptic must not damage the living tissue, must not be toxic in the necessary quantity and concentration, and must not be resorbed

too rapidly from the place of application; also a certain storage, an antiseptic impregnation (47, 64) must take place in order to inhibit or destroy bacteria in a satisfactory concentration, and over a longer period.

With this new form of infiltrative antisepsis some physicochemical questions arise that have not had to be taken into consideration before. Schade has shown in his remarkable intravital measurements of hydrogen-ion concentrations in normal and inflamed tissues that there were different degrees of local acidosis depending on the intensity and duration of inflammatory processes. Transudates, exudates, chronic suppurations and acute abscesses showed an increasing degree of acidosis from 7.25 (pH 37 degrees) to 5.95. Michaelis and Hayashi have proved, on the other hand, that the antiseptic concentration of rivanol is distinctly dependent on the hydrogen-ion concentration. With a hydrogen-ion concentration of 8.4, a 1:32,000 solution inhibited the growth of staphylococcus, whereas a hydrogen-ion concentration of 5.2 decreased the antiseptic concentration to 1:1,000. The lowering of the hydrogen-ion concentration was also followed by a decrease in surface tension. The highest acidity noted in acute pyogenic abscess was 5.95 in Schade's experiments, which corresponds to an antiseptic solution of rivanol, 1:4,000. Concentrations of 1:1,000 to 1:2,000 are, therefore, apparently beyond the limitations of this acidity factor. It is curious to note that trypaflavine did not seem to be influenced by the change in acidity. This local acidosis at the site of the inflammation was the basis of my intravenous urotropine therapy, in which the splitting of urotropin into formaldehyde and ammonia takes place in the infected tissue, wherever it may be, and not in the stomach when urotropin is given orally.

The grade of dispersion is another factor that has to be considered in local antisepsis. A slow diffusion and a high adsorptive character should be postulated in this form of antisepsis. In the inner antisepsis, by the intravenous route, the chemical agent must be easily diffusible, because of a high grade of dispersion and slight adsorption. Therefore, an efficient tissue antiseptic, like rivanol, will not necessarily be useful as an intravenous therapeutic agent. Trypaflavine, because of its physical properties, would seem to be more suitable for this purpose.

THE CLINICAL USE OF RIVANOL

Although animal experiments may lead to valuable conclusions regarding human infection, the conditions are not exactly analagous, and, therefore, the conclusions can only act as a guide in our therapeutic measures. The difference in the amounts and virulence of infecting organisms in human infection, the different defensive reaction of each individual, and the anatomic and physiological differences of various tissues all complicate our problem. And above all, as Brunner (13) emphasized in his classic studies on experimental and clinical wound antisepsis, "in the evaluation of our clinical results, the control animal is always missing." We never can tell what course the infection would have taken with another form of treatment, or without treatment.

We began a clinical study of this dye with the aim of testing its value on localized pyogenic infections. Freshly prepared solutions of rivanol were employed. Doubly distilled water, and later ordinary tap water, were boiled on an open flame; the weighed quantity of rivanol (or tablets containing 10 centigrams) was added, and boiling continued until the dye was completely dissolved. If the injection was to be made subcutaneously or intramuscularly, novocain tablets were added to make up a 0.5 to 0.25 per cent solution. The addition of adrenalin is unnecessary; rivanol itself causes marked vasoconstriction, as shown by Odermatt. Concentrations of 1:500 were used for filling cavities, whereas solutions of 1:1,000 to 1:2,000 were used for infiltration antisepsis. Intravenous injections were not given for the theoretical reasons already stated.

LOCALIZED PYOGENIC ABSCESSES

Aspiration of the pus with bacteriological control, and filling with rivanol, 1:500, was done in 31 cases, following the technique of Haertel and Kishalmy. The normal skin was punctured with a large cannula, 2 to 3 centimeters from the abscess, through an intra-

dermal wheal of novocain. About two-thirds of the aspirated pus was replaced with rivanol. This was repeated every second day, and bacteriological controls were made. An average of three punctures was made. Sterilization of the abscess cavity resulted in 26 of 31 cases (85.8 per cent), but as Haertel and Kishalmy pointed out, healing cannot be expected before the necrotic tissue and the precipitated fibrin-net are removed. These act as a foreign body and lead to sinus formation. Therefore, after the abscess is sterilized, or at least after the virulence of the bacteria is very much reduced, two small stab wounds are made, 6 to 8 millimeters long, the contents gently expressed, and a compression bandage applied. The walls of the abscess being brought together, and no foreign body being present to disturb regeneration, healing takes place in from 6 to 8 days. It might well be asked why make these painstaking injections if, after all, incisions are necessary. The two small stab wounds, however, cannot be compared to the long incisions we are forced to make at the height of inflammation. Painful dressings are avoided; the duration of the process is shortened, and the cosmetic results are much better. Tuberculous abscesses were not treated.

Table I shows our results in localized pyogenic infections. Subcutaneous abscesses and bursitis yielded much more readily to this treatment than glandular abscesses. If after two punctures, the temperature and pulse did not drop, if the inflammatory process progressed or remained stationary, the abcesses were exposed by means of large incisions. The cause of failure, aside from individual degrees of defensive reaction, and a mixed bacterial flora that responds much less to disinfection, according to Ritter's observations, is chiefly the large amount of necrotic material that cannot be removed through the small stab wounds. Besides, the glandular abscesses are always multilocular, and the pockets not so easily accessible. In contrast to Rosenstein's favorable results, Baecker reports only very moderate success in the treatment of mastitis. We obtained the best results with well walled-off, unilocular abscesses, with little necrotic material.

TABLE I.—RIVANOL TREATMENT OF LOCALIZED PYOGENIC ABSCESSES

Diagnosis	Number of cases	Average number of punctures	Duration of treatment, days	Successful Treatment	
				Number of cases	Per cent
Subcutaneous abscess	15	3	8	12	80
Prepatellar bursitis	3	1	6	3	100
Mastitis	10	5	14	6	60
Inguinal lymphadenitis	3	3	10	2	66
Axillar hydradenitis	5	3	15	2	40

PLEURAL EMPYEMA

The treatment of pleural pyogenic empyema is one of the most important phases of thoracic surgery. Although a thoracotomy or a rib resection saves the patient's life and relieves him from the dangers of a generalizing infection, prolonged convalescence with endless sinuses may follow as a result of rib-osteomyelitis, insufficient lung expansion, bronchial fistulæ, and so forth. Fischer (29) recently gave a comprehensive review of the efforts in the closed treatment of empyema, and considers the removal of the fibrin masses one of the most important factors in obtaining permanent results. I had the opportunity to follow his technique in two instances. An extensive rib resection (8 centimeters) is made of one or two ribs, and the fibrin masses on the diaphragmatic surfaces are thoroughly removed. The cavity is carefully irrigated with warm saline solution. If there are no bronchial fistulæ the cavity is filled with about 100 cubic centimeters of a 1:500 solution of rivanol; pleura and muscle are sutured watertight, and positive pressure is simultaneously applied to the lungs in order to facilitate expansion. The skin is pulled together very loosely, and the subcutaneous tissue is drained for a few days. In both of our cases, four further aspirations were made, and the cavities again filled with rivanol until no exudation could be demonstrated under the fluoroscope. In both cases the empyema was metapneumonic; the patients were very debilitated, and pure cultures of streptococci were obtained.

It is evident that only recent cases without thickened pleura will yield to this treatment, and if the lung does not expand, thoracoplasty

will be required sooner or later. It must be emphasized that the antisepsis here is only one of the factors responsible for success; the removal of fibrin and expansion of the lung are just as important. If the lung does not fill in the dead space between visceral and parietal pleura, fluid will always accumulate. At the slightest symptom of pus retention, the wound can easily be opened, and extensive drainage established. In case of success, the avoidance of weary sinuses that eventually require further surgical treatment is very advantageous.

PERITONITIS

Katzenstein and Schulz have reported favorable results with rivanol irrigations and rivanol filling, in cases of diffuse peritonitis. However, since the bacterial flora of peritonitis is very mixed and since the bacillus coli is especially resistant to rivanol, too much cannot be expected in this type of infection. After the removal of the infecting source, the treatment of peritonitis should be general. Glucose, digitalis, and large doses of quinine were given rectally. Rivanol was used in irrigating the cavity after a thorough removal of the pus, but no conclusions can be drawn from our few cases. It is impossible to estimate the value of the drug in an infection of such varying course, and in view of this combined treatment.

JOINT INFECTIONS

As Axhausen had demonstrated that a solution of rivanol, 1:400, could be used on the normal cartilage of the rabbit with impunity, concentrations of 1:500 were injected in cases of purulent arthritis. Again, as in pleural infection, it must be pointed out that sterilization of the joint cavity alone is not enough, and only a combined treatment with precise indications can be advised. Only if the process is superficial, such as purulent synovitis, can chemotherapy be of value. For capsular phlegmon, or perforated periarthritic phlegmon or abscess, disinfection of the joint cavity comes too late. Aside from this anatomic consideration the mechanical removal of all fibrinous and necrotic tissue, combined with perfect immobilization, are equally important.

In an excellent article, Fischer (29) advises the same principle of treatment as in pleural infections; that is, if aspiration and filling with the antiseptic solution do not relieve the symptoms, arthrotomy, complete removal of pus and fibrin, rivanol filling, and primary suture with drainage of the subcutaneous tissue are carried out. The functional end-results are not influenced by the opening up of the joint, if the drainage can only be avoided.

In our 5 cases, this type of treatment proved very satisfactory. In 2 cases of pneumococcal empyema of the knee-joint, which had already been treated elsewhere with extension and rivanol filling, incisions were made on the inner and outer edges of the patella, pus and fibrin masses removed, the joint filled with rivanol, and the capsules sutured with catgut. Active and passive movements were begun on the eighth day. Flexion of 85 and 93 degrees was obtained in 3 months. Two cases of staphylococcal empyema, resulting from pyæmia, were healed by three punctures and refillings which were made every third day. The fifth case was a very severe injury of the knee. The patella was fractured and there were particles of earth and pieces of clothing in the joint. The patient was seen 12 hours after the injury; tetanus antitoxin was administered, the wound cleansed, neurotic tissue removed, the patella sutured, the joint closed, and the whole region infiltrated with rivanol, 1:1,000. The patient developed a very severe periarthritic phlegmon, although the cavity itself remained free from pus. Amputation was considered, but extensive resection of the joint saved the limb; the knee, of course, was stiff. This case really belongs with another group of cases: preventive infiltration of accidental wounds. The reasons for the possible failure of this form of treatment will be discussed with that group.

All therapeutic efforts, so far described, belong to the group of cavity antisepsis, and do not differ materially from the sterilization of wound surfaces. Abscess cavities and infected joints have long been injected with various antiseptic solutions, such as tincture of iodine, phenol camphor, formalin glycerin, and many others. In the sterilization of wound surfaces Brunner regards many other drugs, such as iodine alcohol, Dakin's solu-

tion, and chloramine, as more effective. However, in the treatment of localized infections, the possibility of infiltrative antisepsis with these acridine dyes, trypaflavine and rivanol, is a new principle. Their injurious effect on the living tissue is practically nil.

PREVENTIVE INFILTRATION OF ACCIDENTAL WOUNDS

After the usual mechanical and chemical (iodine) cleansing of the wounds, an infiltration of rivanol, 1:1,000, with 0.5 per cent novocain has been made as in local anæsthesia, under and around the injured tissue. A culture was taken, necrotic tissue excised, visible dirt removed with hydrogen peroxide irrigation, and primary suture made as a routine procedure in our out-patient department. Tetanus antitoxin was administered at the same time.

Eighty-one unselected cases were treated, and so many factors were responsible for the end-results that tabulation of these cases does not seem advisable. This preventive infiltration was a failure in 19 per cent of the 81 cases because the sutures had to be removed for progressive infection. Disregarding for the present the virulence and amount of the infecting organisms, the amount of destruction and the necessary reconstruction (tendon sutures, and so forth), the condition of the blood and nerve supply, the defensive power and general condition of the patient, all of which play an important part in the healing of wounds, two main factors were recognized as having an unmistakable effect on our results: (1) the time which elapsed between injury and treatment, and (2) the bacteriology of the wound.

The effect of the first was demonstrated during the War. Accidental wounds receiving definite treatment within the first 6 hours were primarily sutured and remained clinically aseptic in 89 per cent; wounds treated after the first 24 hours showed primary union in 46 per cent. As these patients were hospitalized and very carefully observed, primary suture was considered permissible, unless anaerobic infection was present.

This leads to the other important factor: the bacteriology of the wounds. As shown by Brunner and Ritter in experimental and clinical observations, mono-infections with streptococci or staphylococci respond very well to rivanol; in case of a mixed flora some influence on the infection can be observed, but it is not definite. Anaerobic infections are resistant to the usual concentration of 1:1,000. A solution of 1:400, injected into the animal simultaneously with samples of highly pathogenic earth, prevented an otherwise deadly tetanus infection (13), and so did trypaflavine and rivanol in powder form (9, 13).

As mixed infections, in all probability containing anaerobes, occur in all accidental wounds, preventive infiltrative antisepsis with rivanol cannot be advised as a routine procedure. The strongest concentration permissible in infiltrative antisepsis is 1:500, but in powder form concentrations as strong as 50 per cent do not interfere with granulations; and the toxicity of the drug, as already stated, is slight. A 2.5 per cent rivanol powder, made up with very finely divided carbamide, has proved successful in sterilizing wounds in experimental staphylococcal infection (63), and in combating anaerobic infections. The use of urea (carbamide) as the base of a powder enables the disinfectant to penetrate much more readily into the deeper structures of a wound. The powder bases generally used, such as talcum or amylum, are insoluble in the wound secretion, agglutinate in lumps, form crusts and disturb regeneration. With carbamide an equal distribution of the drug is obtained, and by virtue of its easy diffusion, chemical and osmotic indifference, and the ease with which it may be applied, the drug seems very suitable for the prophylaxis of accidental wounds. No clinical results have yet been published regarding this form of treatment, and only very large statistics will be of definite value.

PROGRESSING PHLEGMON WITH TISSUE NECROSIS

Morgenroth has been able to sterilize the connective tissue of the mouse in streptococcal and staphylococcal infection. Brunner did not get the same results, and pointed out that conditions in man are much less favorable. In the loose connective tissue of the mouse, the

bacteria are suspended in the comparatively large amount of injected fluid, whereas in the tense subcutaneous tissue or muscle of man, the bacteria are not so easily accessible. Besides, tissue necrosis, as already emphasized, always sets a limitation on our results. I believe that our aim in these cases should be to aid nature in walling off the inflamed area from the normal tissue, and so change the progressive character of a phlegmon into a localized abscess. Carbuncles and furuncles of the face and neck can usually be healed without incision by injecting rivanol, 1:1,000, with 0.5 per cent of novocain around and under the inflammatory process, and gently removing necrotic masses. In 2 of 17 cases, incisions had to be made. The time required for healing was not shorter in the other fifteen, and the cosmetic results, because of the great loss of tissue in carbuncles, were hardly better than with regular incisions.

EXCISION AND PRIMARY SUTURE OF FURUNCLES UNDER ANTISEPTIC ANÆSTHESIA

In order to get rid of the necrotic material, to shorten the time of healing, and to improve cosmetic results, I used the following procedure. After infiltration with rivanol novocain, the furuncle was excised well beyond the border of the inflamed tissue, and the edges of the wound sutured. The sutures must not be too close together, and a small rubber tube or a silkworm drain may be inserted for 24 hours. One large carbuncle of the thigh, and 8 furuncles of the face were treated in this way; primary union was obtained in every case. No excision was made in cases with accompanying lymphangitis or marked collateral œdema. Furuncles on the face should be treated in this way only if they are well walled off and small, so that no tension has to be applied when the skin is sutured. With these limitations, if there is an unbroken antiseptic wall, propagation of the infection need not be feared. Brunner has shown that the healing of wounds is not disturbed by antiseptic irrigations and infiltrations during aseptic operations. Undoubtedly, some of these furuncles, if excised far enough from the demarcation line, would heal without an antiseptic, but the antiseptic wall affords greater safety.

INFECTIONS OF THE HAND

Infections of the hand, in which anatomic peculiarities add to the difficulties of treatment, are not well suited for rivanol. Acute and chronic forms of suppurative tenosynovitis and fascial space abscesses, studied so extensively by Kanavel, are not walled off sufficiently from adjacent spaces, and slight necrosis may interfere with later function. However, as Rosenstein reported favorable results, treatment with rivanol was tried in two instances of acute tenosynovitis of the hand. Pus was aspirated from the tendon sheath; the aspirating needle was left in place, and another inserted proximal to the infected area, to wall off the infection by infiltration, and to irrigate the tendon sheath if possible. Although the inflammatory process was stopped, both patients complained of great pain; the duration of the healing process was not shortened, and the advantages of early and adequate incisions were evident. I did not, therefore, feel justified in giving this treatment further trial.

ERYSIPELAS

If, as it appears, rivanol has an elective affinity for streptococci, then erysipelas, a mono-infection, a streptococcal lymphangitis of the cutis, that ordinarily does not result in tissue necrosis, ought to be susceptible to infiltrative antisepsis. Rosenstein reported some cases in which injections of rivanol were made under and into the inflamed area with satisfactory results. Bange, in Bier's Clinic, found that rivanol has a definitely inhibitory effect on the propagation of this infection, but concluded that it only acts, as many other unspecific drugs, by producing hyperæmia. Novocain or normal saline injections also inhibited the process for some hours, and X-rays or ultraviolet rays produced greater hyperæmia and were much easier to administer.

No perfectly reliable cure for erysipelas has yet been found. The course, duration, and recurrence of this infection being so variable, it is difficult to judge the effects of any treatment. An attempt was made to block off the progressing superficial infection with rivanol. The technique was as follows: About 6 centimeters from the line of demarcation a sub-

cutaneous ring was made around the inflamed area. A few minutes later another ring was made with a fine intradermal needle in the form of wheals over the subcutaneous ring. A solution of rivanol, 1:1,000 with 0.5 per cent novocain was injected. The subcutaneous injections are no more painful than the injection of pure novocain, and within a few minutes the skin above becomes perfectly anæsthetized so that the intradermal injections are not felt at all. The wheals should not be too large, or they may cause infiltration, owing to the increased pressure of the injected fluid. As the streptococcic lymphangitis is not only present in the skin, but in the subcutaneous tissue, and can be found in microscopic sections some distance from the visible border of inflammation, this possibility must be considered in the blocking of both layers. Thus, an antiseptic depot is established in the skin and connective tissue, that is ready to attack the progressing infection under the most favorable conditions. The two important principles underlying this mechanism are antiseptic impregnation and transgression from tissue cell to parasite (47).

Eight cases were treated in this way, and no other treatment, except an antiseptic ointment, was given. In 5 cases erysipelas affected the extremities; in 2, the face; and in 1, the trunk. With the exception of the latter, all the infections were of short duration, 1 to 2 days, and it was thought that the therapeutic effect would be more evident in such cases. The inflammation stopped definitely before the antiseptic wall in all cases except 1, in which the ring was too far away. In this case a second ring was made which stopped the process definitely. The erysipelas of the trunk was of a wandering type. It had persisted for 6 weeks, and all other forms of treatment (iodine, silver nitrate, antistreptococcal serum, foreign protein, intravenous collargol) had been tried without benefit. An area, 16 by 25 centimeters, in the lumbar region, was walled off, except at the uppermost point, where 1 centimeter of the epidermis and cutis were not injected. Circular expansion of the process ceased, except at the point where injection had been omitted; here it crawled upward. A second, complete ring stopped the process entirely.

It is by no means expected that this antiseptic circle, around an area affected with erysipelas, will constitute an absolutely successful procedure in every case; yet its theoretic importance and practical value are worth considering. That intravenous disinfection would be a simpler method is undoubted. Urotropin was ineffective in my experience; perhaps mercurochrome 220, as recently reported by Young and Hill and by Young and Birkhaug, will be more effective for erysipelas. But especially in early cases, in which the extremities are affected, the use of this infiltrative antisepsis is very promising for general practice.

ANTHRAX

This type of infection, although rare in western Europe and the United States, is quite common in Hungary. In the out-patient department of the First Surgical Clinic of the University of Budapest, between 20 and 35 cases are seen every year. In 1923 38 cases were observed. As it has been recognized that any radical treatment, such as excision or cautery of the malignant pustule, tends to break down the defensive barrier of the patient, only from 50 to 200 cubic centimeters of anti-anthrax serum was given intramuscularly at various intervals. Locally, a dry antiseptic dressing was made. We can only confirm Regan's statement that anthrax in man is primarily a localized infection, and has a tendency, in a large proportion of cases, to remain localized. Only 2 of our last 38 patients died, both of whom arrived at the hospital moribund, the pustules having been excised elsewhere. I have not tried local serum injections, as advised by Regan, but used rivanol to block the spreading infection in our last 12 cases.

The three typical zones, the central depressed eschar, elevated white brim, and the red areola around it, were infiltrated, if possible, on the border of the soft surrounding œdema. Ten of these cases looked benign from the beginning, and would surely have healed without any local treatment. However, 2 of the cases had a very virulent course. One patient had a pustule on the dorsal surface of the hand, with symptoms of beginning generalization, nausea, fever, and diarrhœa. The

œdema spread rapidly on the forearm, 6 centimeters in an hour. Serum was injected into the thigh in doses of 150 cubic centimeters every 8 hours; yet the œdema continued to spread. Just below the axilla, above the borderline of the œdema, a circular infiltration of all layers from skin to bone was made with a concentration of rivanol, 1:2,000. A slight swelling followed this procedure. The œdema stopped at the point of this infiltration, and the patient recovered. The other patient had a pustule on the hair line in the temporal region, a shaving brush infection. The œdema spread over the ear, down to the neck, and into the loose tissue of the eyelids. At the site of circular infiltration, the œdema stopped.

No definite explanation of these results can be given. The sporicidal action of rivanol is very slight (15), but an inhibition in growth, a decrease in the virulence, and an antiseptic sealing off of the lymphatics may have prevented further generalization. Once the organism has been localized and weakened, the host seems to be able to throw off the infection by itself. The same principle as in the treatment of erysipelas may be observed here: an antiseptic, preventive infiltration of a slowly resorbable drug (64), which has more chance to act than if it were injected into the infected tissue.

Favorable results have been reported with rivanol in dentistry (1, 22, 32, 34), dermatology and urology (36), chronic gynecologic infections (31), ophthalmology (43), and veterinary medicine. No attempt has been made to review the literature, as I have had no personal experience in these fields.[1]

DISCUSSION OF CLINICAL RESULTS

In view of the various factors that influence the course of infection in man, clinical results must be weighed with great caution. It seems from reports in the literature, especially Brunner's admirable studies, and from our own observations that rivanol in the concentrations used, 1:500 in cavities, 1:1,000 to 1:2,000 in infiltration of tissues, does not destroy the tissues and has an elective affinity for streptococci and diphtheria bacilli (26,58). Staphylococci are not so susceptible to rivanol, but are markedly influenced; bacillus coli and pyocyaneus are very resistant. The concentrations used in infiltrative antisepsis are insufficient to combat anaerobic infections, but strong solutions of 0.5 to 1 per cent, or the drug in powder form, applied on the surface of the wound, will save the animal from death (15). Another limitation of efficiency is seen in the presence of necrosis. If necrotic material can be removed by surgery, or if antisepsis is established before its appearance, optimal conditions are present.

A direct, antimycotic action of these dyes cannot be denied, as is best indicated by their elective affinity for certain organisms. An absolute disinfection in the tissue, a condition which is scarcely conceivable, is not essential to clinical results; if the virulence is decreased and the poison fixed by rivanol, diphtheria toxin could be neutralized by rivanol (58); the defensive power of the patient will then overcome the infection. It is the great merit of Morgenroth to have given us an antiseptic which can be used not only intravenously and on the surface of wounds, but also in human tissues, by means of local infiltration.

SUMMARY

Chemotherapy was originally a treatment of infection with chemical agents that had a specific action on the infecting organism. The rôle of the host was disregarded in this original conception, but has gained more and more in importance. It is now realized that the direct disinfectant or inhibitory action on the parasite must never suppress the defensive power of the host. Several facts are mentioned which prove an active co-operation on the part of the host.

The direct disinfectant or inhibitory concentration of a drug, as shown in the test tube, can serve the purpose of initial orienta-

[1]Since this paper was sent in for publication, two good reviews have appeared. Block, a clinician, has emphasized the non-specific tissue-stimulating property of rivanol, and also its antiseptic effect. Laqueur and his coworkers tried the subject from a pharmacological point of view, and show in a recent article that rivanol in a concentration of 1:1000 agglutinates erythrocytes in defibrinated blood. Washed erythrocytes are hæmolyzed in the same concentration. Therefore, caution should be applied in its intravenous use.

Block, W. Kritisches Sammelreferate ueber die Wirkung des Rivanols Deutsche med. Wchnschr., 1924, 1, 1133–1134; 1164–1166.

Laqueur, E., Grevenstuk, A., Sluyters, A., and Wolff, L. K. Die neueren chemotherapeutischen Praeparate aus der Chininreihe (Optochin, im besondern Eukupin und Vuzin) und aus der Akridinreihe (Trypaflavin, Rivanol). Erbegn. d. inn. Med. u. Kinderh., 1923, xxiii, 467–555.

Laqueur, E., Sluyters, A., and Wolff, L. K. Experimentelles ueber das neue chemotherapeutische Antisepticum "Rivanol." Ztschr. f. d. ges. Exper. Med., 1924, xlii, 247–266.

tion, but the value of animal experiments, acting as living test tubes, are beginning to be fully recognized. The absolute disinfective index of a drug is the ratio between its disinfectant concentration *in vitro* and its disinfectant concentration in the living tissue. The ideal index is 1:1, that is, the antiseptic properties of the drug are not inhibited *in vivo*. Other methods of experimental evaluation in the living tissue are described.

As a member of the group of acridine dyes, 2 aethoxy—6.9 diamino-acridine (rivanol) was synthesized by Morgenroth in 1921. A physicochemical and pharmacological description of it is given. The antiseptic index is 1:2.5 for streptococci, and more than 1 for staphylococci; rivanol, therefore, has an advantage over trypaflavine. Rivanol is also much less toxic and more slowly resorbable than the latter, and is therefore especially suitable for local antisepsis.

For clinical use the concentrations varied from 1:500 to 1:2,000. In tissue infiltration 0.5 per cent of novocain without adrenalin was added.

Localized abscesses were healed by a few punctures, if the necrotic tissue could be removed through small stab wounds. Course, duration, and cosmetic effect were favorable. Glandular abscesses, like mastitis, lymphadenitis, and hydradenitis, do not respond well to this treatment because of the large amount of necrotic tissue.

The rivanol treatment of pleural empyema and of joint infections is based on the same principle: removal of all necrotic tissue and fibrinous masses, and water-tight closure of the cavity itself with ample drainage of the subcutaneous tissue. The sterilization of the infected cavity is only one factor in obtaining the desired result. The indications for this closed therapy are naturally limited.

Peritonitis was treated with rivanol irrigations, but no conclusions can yet be drawn as the number of cases is too small.

Prophylactic infiltrations of accidental wounds show that mono-infections of streptococci and staphylococci can be treated with primary suture, especially if the treatment is instituted early. Anaerobic infections are a contra-indication to this treatment; wide exposure of all pockets, peroxide and iodine alcohol, and eventually rivanol infiltration are advised as local treatment by Brunner. The use of 2.5 per cent rivanol with carbonide powder in wound prophylaxis seems experimentally sound, and deserves a trial.

The results in cases of progressive phlegmon with tissue necrosis, infections of the hand, carbuncles and furuncles, were not satisfactory, although it was possible to arrest the process.

Excision and primary suture of furuncles, under a defensive wall of antiseptic anæsthesia, were successful in a few cases.

In erysipelas a circular intradermal and subcutaneous ring around the inflamed area had a definite effect on the process. Being a streptococcal infection, generally without necrosis, the success of the treatment is well based on experimental findings.

Rapidly progressing cutaneous anthrax was arrested in two instances by circular infiltration with rivanol.

Favorable results have been reported in various specialties.

The chief value of rivanol, then, as seen in clinical observation, aside from the possibility of sterilizing infected cavities by a non-toxic and non-caustic chemical agent, is the building up of an antiseptic wall between focus and general circulation by means of circular infiltrations around the progressing infection. No doubt clinical agents with a more universal action against bacteria will be found, but Morgenroth deserves great credit for proving that tissue antisepsis. in the prevention and cure of localized infection, is practicable.

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SOME DEBATABLE POINTS IN THE SURGERY OF THE GALL TRACT[1]

By WILLIAM D. HAGGARD, M.D., F.A.C.S., Nashville, Tennessee

IN the perfection of the surgery of the gall tracts the most debatable point has been the indication for removal of the gall bladder. Out of 345 cases of gall-bladder operations in our clinic (1919–1923), exclusive of stone in the common duct, 297 were cholecystectomies. Approximately 85 per cent were removed instead of drained. In 70 per cent gall stones were present. The mortality in the combined series was 4.04 per cent.

It is notorious that cholecystotomy in the absence of stones gives very unsatisfactory results. It is estimated by Bancroft that only 50 per cent are cured and in the hands of many surgeons cholecystostomy in the unbenefited is often followed by a secondary cholecystectomy.

The majority of gall-bladder infections with or without stone are frank and satisfactorily diagnosed.

In some cases the symptomatology is not attended with definitely recognizable pathology. In the usual case upon exploration the gall bladder either contains stones that are easily palpated, or the gall bladder is thickened or surrounded by adhesions.

It may have deposits of subperitoneal fat and no stones may be palpated. A normal gall bladder is blue; but a blue gall bladder is not always a normal gall bladder. Under certain circumstances one may have to open the gall bladder to make a diagnosis. Occasionally very small stones are found when it was not possible to palpate them through the gall-bladder wall. Again we find the typical strawberry gall bladder, which requires removal. Characteristic of the strawberry gall bladder is the small, elevated, whitish area caused by a deposit in the mucosa of an ester of cholesterol, which lipoid substance when sufficiently deposited as to be discernible by the naked eye, has a fanciful resemblance to the strawberry seed.

If, however, the lining membrane appears normal, one hesitates about removing the gall bladder and dislikes more to drain it. It is certainly unwise to drain a gall bladder that is not bad enough to take out, in the absence of stones and in the absence of any mucosal change. A section of the wall has been removed by Judd for pathological examination. He refers to occasional cases in which the pathological changes were not recognizable and the incision was closed without removal. A few such cases had continued symptoms, apparently requiring another operation with relief. We can hark back under those circumstances to the old operation of cholecystendysis or immediate closure of the gall bladder. If we make a wrong diagnosis it is not necessary to remove the gall bladder to support the diagnosis. Crile contents himself with making the decision by inspection and palpation. Unless convinced of demonstrable pathology, he does not open, drain or remove gall bladder.

It is probable that small stones form in the mucosa as a result of these cholesterol deposits. It has been experimentally proved by Drury and others, that "cholesterol precipitation in human bile can be induced or prevented by slightly altering the reaction of the fluid toward the alkaline and acid sides respectively."

The last 100 autopsies in the Mayo Clinic showed diseases of the gall bladder either macroscopic or microscopic in 4 per cent. Hubbard found that in 46 autopsies on bodies in which gall stones were revealed 6.5 per cent died as a result of their presence, from such complications as empyema of the gall bladder, acute pancreatitis, etc. Fifty per cent in which stones in the common duct were found died from the condition.

FOCAL INFECTION

Focal infection has made a signal advance in prophylactic medicine as well as in its therapeusis. It has not been indisputably proved. We are prone to give to each new theory more credit than it finally holds. The intriguing theory of Rosenow relative to the selectivity of micro-organisms when they emi-

[1]Read before the Clinical Congress of the American College of Surgeons, New York, October 28, 1924.

grate from their habitat is most far-reaching. From the original focus the gall bladder is believed to be infected and later the infection is relayed to other organs. It is emphasized by W. J. Mayo that certain forms of cardiac diseases are very closely associated if not caused by gall-bladder infection. He refers to the heart lesions of adolescence, which in the presence of gall stones, are very strikingly relieved by their removal. There is little danger in this type of noisy heart associated with chorea. Mayo said he had never seen a surgical death result in these circumstances. Attention is called to essential hypertension. Hypertension due to many causes is very frequent in women of overweight who have gall stones and they are markedly improved as to their hypertension by operation for the gall-bladder infection and without much danger so far as death from hypertension is concerned. Syphilitic aortitis is believed by him to be frequently associated with angina and when gall stones are present the angina seems to be greatly benefited by operation without much danger in spite of the angina. Willius in the Mayo Clinic noted coronary sclerosis associated with disease of the gall bladder in 24 per cent. The cardiorenal type and the toxic variety of heart disease apparently have no relation to gall stones. The arthritides which are due to focal infection particularly from the gall bladder are most satisfactorily cured by removal of the cause which also may be said of certain forms of muscular rheumatism.

The relationship between gall stones and appendicitis has been stressed by Moynihan, and Mayo has recited very striking examples of simultaneous acute infections and perforation of the appendix and the gall bladder. Surgeons generally agree that if feasible it is wise to remove all appendices with any evidence of pathological change during operation upon the gall bladder.

The relation between gall stone and pancreatitis is well-known and inasmuch as it is the resulting complication and pancreatitis is such a murderous disease, it is a very positive and very valid argument for early operation in gall-bladder infections and calculus. Acute pancreatitis resulting in many cases from stone in the ampulla of Vater allowing retrojection of bile direct through the duct of Wirsung causes the most dramatic syndrome in all medicine. Reginald Fitz has very graphically described it. When an elderly man previously well or an occasional sufferer from indigestion is suddenly seized with a severe, agonizing epigastric pain, associated with vomiting, followed by collapse and within 24 hours with a fluctuant epigastric tumor, acute pancreatitis may be diagnosed. The diagnosis is usually that of intestinal obstruction and because of the vomiting, obstipation, and great pain prostration and death will follow, if patient is not relieved. It is not to be understood, however, that the subacute type of pancreatitis even with hæmorrhage, the apoplectic variety, or with fat-neorosis is necessarily fatal, even without operation, although these cases do remarkably well when the gall-bladder stones are removed and the gall bladder drained. The gall bladder should never be removed, if there has been any jaundice or other evidence of obstruction in the common duct. The gall bladder may subsequently have to be utilized to sidetrack the bile either to the stomach or to the duodenum.

Relationship of chronic biliary cirrhosis caused by infections of the gall bladder especially following stone in the common duct, as described by Adami is no longer debatable. Moreover, removal of the cause is very beneficial unless too much connective tissue has been deposited around the bile radical to prevent complete cure and cause slight jaundice more or less permanent.

Association of hepatitis with cholecystitis. Graham has very beautifully shown that infection of the gall bladder is probably secondary to infection of the liver. Hepatitis comes from the portal circulation and is transmitted to the gall bladder by way of the lymphatic connections between the two organs.

Heyd believes inflammation of the liver leading to fibrous thickening of Glisson's capsule, comes from severe inflammation in the region of portal drainage, most common about the appendix, and "extends from the liver to the gall bladder either through the bile or through the lymphatic channels and the cholecystitis, thus initiated, may subsequently in

its repeated exacerbations bring about localized or even general hepatitis by lymphatic extension of the infectious process."

Strachauer suggests that, when one is unable to decide definitely at operation from the physical signs what is the condition of the gall bladder, a small section of the liver be examined under a frozen section and that if evidence of hepatitis with round cell infiltration is present the gall bladder be removed in order to eliminate the vicious circle.

Relationship between gall-stone disease and glycosuria is fairly definite. Diabetic pancreatitis patients can be very satisfactorily prepared for operation with insulin and give a fair degree of assurance that the sugar will permanently disappear in some cases.

The method of determining the liver function with phenolsulphonephthalein, introduced by Rosenthal, is based on the ability of the liver alone to remove the dye from the circulatory blood in a given time.

Under conditions that are normal the dye leaves the blood rapidly but when there is dysfunction of the liver it is retained and is very high for several hours. This degree of retention in the blood gives a very definite indication as to the severity of the disturbances in the liver. A retention as high as 8 per cent at the end of 15 minutes is considered normal. One of the greatest advantages of this test of Rosenthal's is in those cases in which there is no obvious liver dysfunction and there are no clinical evidences of any disease of the liver. This is the type of case in which a liver function test is of great importance as an aid to diagnosis and a guide to therapeutic management.

Some cases of chronic cholecystitis showed a moderately severe dysfunction, about 2 per cent of the dye being present at the end of 2 hours. Cirrhosis gives the highest percentage of retention. It is obvious that there is a real value in this test of liver function.

Charles Gordon Heyd has graphically described three types of deaths that occur after operations upon the gall bladder or ducts and that cannot be explained by surgical trauma or shock, sepsis, gastric dilatation, or kidney insufficiency. These he attributes to hepatic insufficiency. Type one is a case that goes into profound, vasomotor depression at the end of 24 or 36 hours after a cholecystectomy without apparent reason. The patient's skin becomes cold, clammy, moist, and leaky. There is mental stimulation. These cases usually respond to the intravenous administration of glucose, and tap water proctoclysis every 4 hours. He interprets this as being due to some pancreatic toxin or ferment following surgical trauma that the liver handles inadequately. Type two is a progressively developing coma which usually comes on 4 or 5 days after a relatively simple gall-bladder operation in the chronically jaundiced individual and usually terminates fatally with high temperature in 12 to 48 hours. Type three is less frequent and usually occurs in patients with a long history of gall-bladder or duct infection. They pass into a coma immediately after the operation, with high temperature, rapid pulse, and mental excitation, and chemical analysis shows an alkylosis. Heyd has been able to save his last two out of six cases by the internal administration of dilute hydrochloric acid. We have all seen these desperate, stormy terminations to an apparently successful operation, and at postmortem have been unable to find sufficient evidences to justify any explanation other than liver insufficiency.

X-RAY DIAGNOSIS OF GALL STONE

This question has been very thoroughly discussed and still the difference between the most enthusiastic advocate and the most pessimistic is quite wide and even the most conservative shows that about 52.9 per cent positive report of disease is correct in X-ray studies, and a negative diagnosis in 44 per cent in which the pathological evidence was varied from the mild to the most extreme grades of disease, according to Carman and McCarty. Fewer than one-half of the cases of diseased gall bladders were revealed by the X-ray. They say that about 38.4 per cent of gall stones have been revealed by the X-ray, but that even typical shadows with the denser circle around the periphery may be confused with a dozen or more circular shadows of which kidney stones and calcified areas in the structures near by are the most frequent. The

shadow of a pathological gall bladder is still more elusive of determination. Unless the liver and kidney outline can be identified accurately, no shadow should be regarded as satisfactory definition. When these are isolated the third shadow anywhere between the tenth rib and the crest of the ilium may be a diseased gall bladder. However, Carman enumerates fourteen other conditions casting shadows that may simulate the elusive gall bladder such as the upper pole of the kidney, an enlarged caudate lobe of the liver, an unusually broad twelfth rib, food in the hollow viscera, etc. Nichols has shown 75 per cent of stones in the Cleveland Clinic.

The indirect evidence such as deformities of the stomach and duodenal cavities and of the antrum of the stomach, hepatic flexure, plastic phenomena and filling defects in the viscera, abnormalities of motility, is even more nebulous. However, Case found 88 per cent positive in these indirect signs. On the other hand, George and Leonard say if only one minor type of indirect evidence is present, it is questionable.

X-ray visualization of the gall bladder by circulation injection of the sodium salt of terabromphenolphthalein (Graham and Cole[1]) is a helpful addition. The dye causes a shadow of the gall bladder reaching its greatest intensity in from 8 to 24 hours and disappearing in 48 hours. Interference with filling, and hence no shadow, suggests obstruction due to gall stones or other pathological conditions. Unvarying size indicates loss of elasticity, mottling of the shadow suggests stones or papillomata.

In 25 cases of gall stones Carman found the dye of conspicuous service in all but two and of 39 positive cases subsequently operated upon, 36 had given definite abnormal responses. Cirrhosis may prevent secretion of the dye and no shadow is cast.

Biliary obstruction when known to exist is contra-indicated on account of the severe reaction with nausea, vomiting, and prostration, like a vasomotor shock continuing sometimes for 8 or 10 hours with a fall in blood pressure. The test requires hospitalization for a day; the films are made at the end of 5, 8, and 24 hours.

Graham has employed it in about 100 cases and Carman in 200 cases. The former (personal communication) says "like any other X-ray examination the most important question is the interpretation of the plates." Carman is of the opinion that, if the reaction following the injection of the dye is overcome, the method will be comparable to the use of barium in the diagnosis of diseases of the gastro-intestinal tract.

Graham thinks that the reactions can be reduced by the use of freshly distilled water in making up the solutions.

HISTORY

Nothing is superior in diagnosis to a well-taken and carefully recorded history. Of course, an X-ray demonstration of stones is indisputable, if positive, but when negative means nothing, and often stones are present when too soft to show shadows. Attacks of colic may be followed by a certain type of indigestion between spells or with periods of comparative health. Again there may be stomach trouble as the most conspicuous symptom with occasional gall-bladder attacks or the entire symptomatology may be ostensibly gastric. Intervals of freedom from pain are very suggestive of gall stones, whereas it is well known that in malignant disease the symptoms are either constant or increasingly severe and over a relatively short period with little or no improvement. Deaver in his picturesque way paraphrases the classic description of the gall-stone patient as "fair, fat, and forty with belching," which is, of course, most significant. As scarlitinal infections are to nephritides, so gall-bladder inflammations were formerly thought to be dependent upon typhoid. With the great abatement of typhoid, however, gall-bladder infections are not decreasing.

ACUTE CHOLECYSTITIS

The rarity with which patients ever die from acute cholecystitis when left alone should compel us to avoid operation in the acute stages, which is notoriously dangerous. The

[1] Graham, Cole, and Copher have gone back to the tetraiodophenolphthalein which they have now been able to purify. It is just as effective as the tetraiodophenolphthalein and much less toxic. It was used in the first work of this kind but on account of being impure was discarded. J. Am. M. Ass., 1925, April 18, 1175.

exception to this might be in the two extremes, namely, in the very beginning of an acute attack before pathological changes make the operation at all difficult and in the severe gangrenous type in which the gall bladder should be removed. Even these cases, however, are better left until nature isolates the gall bladder by adhesions and an operation can be done secondarily at the end of ten days or two weeks better than it can the first four or five days.

In the preparation of jaundiced patients for operation, the technique of Walters of the injection of 5 to 10 cubic centimeters of a 10 per cent solution of calcium chloride in water injected intravenously every day for 3 days, has a very decided influence in increasing the coagulability of the blood and lessening its clotting time. It seems to be non-toxic and is practically eliminated in a few hours.

The danger of serious and sometimes fatal oozing in operations on the jaundiced is very greatly reduced, especially if it is combined with blood transfusions in suitable cases. It is not to be supposed, however, that it is an absolute preventive. I have known of two cases in which after this preparation death ensued from hæmorrhage, one on the sixth and the other on the seventh day from removal of a drain in one case and from a small decubitus ulcer on the anterior lobe of the liver where it came in contact with the incision, that oozed fatally in the case of one of my colleagues, filling the abdomen with blood. It is important, therefore, to watch the coagulability each day after operation to supplement the so-called "therapeutic course" in the preparation of the case by subsequent instillations of calcium chloride with or without blood transfusion. The patient is not safe, therefore, from secondary hemorrhage at the conclusion of the first few days after operation. Crile has reported a case with fatal secondary hemorrhage in spite of massive transfusions and calcium chloride.

STONE IN THE COMMON DUCT

While it is possible and becoming more common to operate for stone in the choledochus during the attack, even in the presence of jaundice, it is, however, generally speaking, better to tide the patient over the attack, particularly if the jaundice shows any evidence of subsiding, and operate in the interval. That was the old rule and a very good one. With the improvement in results and especially the ability to prevent secondary hæmorrhage by newer methods with the use of calcium chloride the operation can be performed now with greater safety. It is wise, however, not to remove the gall bladder while a patient has jaundice. Drainage is very essential and the gall bladder is utilized for that purpose gether with an independent drain at the site from which the stone is removed from the common duct.

In the bad cases, drain the gall bladder and leave the stone in the common duct as urged by Crile, just as in the two-stage operation we drain the urinary bladder and leave the obstructing prostate. Biliary obstruction with resulting liver insufficiency is similar to kidney insufficiency from prostatic obstruction. Decompression is the primary indication in both.

INJURIOUS INFLUENCE OF THE USE OF THE ULTRAVIOLET RAY ON OLD X-RAY BURNS

By L. L. McARTHUR, M.D., F.A.C.S., Chicago

BELIEVING, as I do, that the general surgeon as well as the general practitioner has held in the past an altogether too complacent opinion of the innocuousness of the ultraviolet ray, regarding it as a scientific plaything with mild potentialities for good, I deem it my duty to report and demonstrate at this time the disastrous influences the ray may sometimes wield. This appears to me to be the more imperative since the experiences and teachings of those most familiar with its therapeutic values are diametrically opposed to the deductions to be made from this case.

Careful search in the literature reveals the general consensus of opinion among radiologists that the ultraviolet ray is the complement (therapeutically) of the X-ray; that while the X-ray produces a late burn (7 to 15 days), the ultraviolet does so in 24 to 48 hours; that the use of the ultraviolet ray following an X-ray treatment will ameliorate or even prevent an X-ray burn, and so its employment is recommended; that while the X-ray is destructive in its influences, the ultraviolet is constructive; that while the large dose of X-ray destroys the red blood cells and lowers the white count (sometimes to 1,500), the ultraviolet ray improves both the number and character of reds and induces a leucocytosis as high as 15,000 to 18,000; that while the X-ray acts as a depilatory, rendering an area often permanently denuded of hair, the ultraviolet may convert even the delicate lanugo into a strong pigmented growing hair.

Even granting that these claims have been demonstrated many times in many hands, there yet remain several incongruities in the further claims for the potency of the ultraviolet ray, which nullify in part the above contentions and leave one in doubt as to its innocuousness. Thus, Potthoff has shown that the ultraviolet ray has a most decided bactericidal effect, for by exposure to the direct rays, he has proven their ability to kill pathogenic germs in 18 to 60 seconds; some common saprophytic germs in 3 minutes; and even the spore-bearing ones in 7 minutes. Can a light so destructive to these be wholly innocent to the almost equally fragile human cell?

If the average drinking water can be rendered safe and potable by flowing down a trough over a series of rills subtended by ultraviolet lamps, can we count with safety on absence of injury to the tissues of the human body similarly exposed? That we cannot, has been *disastrously* demonstrated by those rendered blind through the unprotected influence of these rays upon the lens, inducing prematurely senile cataract, upon the macula, inducing atrophy, as in the case of movie actors' and actresses' eyes subjected to the concentrated effect of numberless mercury vapor lamps used in their studios.

Physically, the ultraviolet rays are closely allied to the roentgen-rays (also a form of light). Ever shortening from beyond the ultra red wave length, in which as in the wireless, they may be miles in length, down through the spectrum color scale, with 12,000 Anstrom units for the red to the ultraviolet with 1,800 units, we come to the radium rays, and finally the infinitely short wave lengths of the modern high voltage Coolidge tube emissions. Knowing how closely together these three lie in their light source, are we not compelled to regard them with proportionate suspicion of their dangerous potentialities?

Just as by "trial and error," we have arrived at a reasonably safe control of the X-ray in its usage, should we not by this "trial and error" on the human being, take advantage of its lesson and regard less complacently the indiscriminate use of a wonderful force for good, when intelligently controlled?

A brief history of a case in point follows:

Dr. C. P. admitted to St. Luke's Hospital (No. 142459), Chicago, September 14, 1920; age 42 years;

dentist. On December 8, 1919, while at work at his profession, patient drove into his little finger (right hand) and broke a steel drill. He sought immediate removal of the fragment from the little finger by a surgeon who made an effort under the fluoroscope to remove it. It is estimated 25 to 30 minutes were occupied in the procedure. Eleven days later, a severe X-ray dermatitis developed, extending from the middle of the forearm to the dorsum of the hand and to the third, fourth, and fifth fingers; over the inner half of the back of the hand over the tendons of the ring and the little fingers. There remained on May 25, 1920, a circular area of white gangrene, 2 centimeters in diameter. At this time, nearly 6 months after the exposure to the X-ray, patient was induced by a friend to have the ultraviolet ray used. This was done May 25. One week later, a similar exposure of 5 minutes at 6 inches distance was again made. The conditions becoming decidedly worse, the patient refused further treatments, and continued those applications that he had been using from the beginning of the X-ray burn, such as Dakin's solution, emollients, and occasionally, when the pain was too distressing, a few drops of a 4 per cent novocain solution. Nothing of especial interest appears in the history of the patient as bearing upon this condition.

Patient was 42 years of age; had 4 children; no family history of tuberculosis or cancer; was a moderate smoker; had no venereal history; and no severe previous illnesses. At the time of admission to the hospital, his hand presented an alleged X-ray burn, with white gangrene of right hand from middle out, extensor tendons of little and ring fingers gone, contractions of the fingers, and extension of the burn halfway to the first joint, from the back of hand on these fingers and on the inner side of the middle finger.

On September 18, 1920, the destruction of the fourth and fifth fingers was so great that it was decided to amputate them and save enough flap to cover the articular ends of the third and fourth metacarpal bones. The gangrenous area was dissected off the back of the hand down to the periosteum, as the tendons had already sloughed. The burn on the inner side of the first phalanx of the middle finger was likewise denuded, and Thiersch grafts applied. At the end of 10 days, it was evident that these grafts had failed to grow on the area of such lowered vitality. It was, therefore, determined to make a pedicle graft from the right abdominal wall, covering two-thirds of the back of the hand with a flap turned up from the right hypogastric region of the abdomen, the pedicle containing the main branch of the superficial epigastric artery. At the end of 18 days, this flap was detached from the abdomen and remained living on the dorsum of the hand—a satisfactory covering to the raw surface.

DEPARTMENT OF TECHNIQUE

RHINOPHYMA

A Report of Six Cases Cured by Radical Operations Followed by X-Ray and Acid Treatments to Relieve the Associated Hypertrophy of the Skin and to Reduce the Operative Scars to a State of Invisibility[1]

By JAMES FRANCIS GRATTAN, M.D., New York

IN the fall of 1919, the writer had the opportunity of performing an impromptu operation in a case of rhinophyma, without the ordinarily necessary formality of consulting textbooks or surgical authority concerning the technique necessary to effect a reasonably good result. In short, on 3 hours' notice, without preparation, a radical excision and subsequent plastic reconstruction was attempted. Perhaps the lack of time for consulting the case reports of men who had handled these cases according to the French and Italian technique of serial decortications with subsequent skin-grafting, caused, through necessity, the invention of a new radical procedure which allowed the removal of the tumor and the reconstruction of the nose to normal contour in one operation. The follow-up treatment with the X-ray, alternating with applications of trichloracetic acid, resulted in the leveling of the skin of the nose and adjacent areas of the cheeks, and to the surprise of all concerned, eliminated the visibility of the operative scar.

The complete report of this first case, with the technique of the operation, and of the X-ray and acid treatments, has been published.[2]

Case 1. M. G., a man, aged 43, single, dated the initial change in the tip of the nose to his tenth year, when, he said the end of the nose was severely lacerated by a dog bite. He did not recall whether or not there was infection present at that time. At 11 or 12 years the patient had facial erysipelas involving the cheeks, eyelids, and nose. This attack kept him in bed for 2 weeks. During his youth he sustained several bad blows and falls involving the nose. Two and a half years before we saw him he had had a second attack of facial erysipelas. The venereal history presented nothing of interest in relation to the local condition. The history of repeated traumas and infection is of value only in the vague sense in which are associated repeated irritation and tumor growth.

Physical examination. The patient was of medium build and, aside from the nasal tumor, apparently without lesions, deformities, or organic disturbances. There was a globular tumor about 1¼ inches in diameter, almost a perfect sphere, with a base almost as broad as the diameter of the mass and extending upward on the anterior surface to the junction of the middle and lower thirds of the nose, and

[2] J. Am. M. Ass., 1920, lxxiv, 1450.

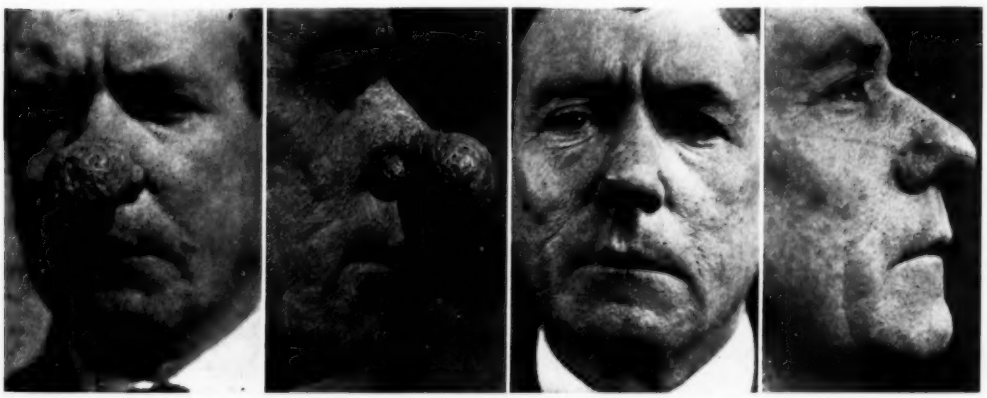


Fig. 1. Case 1, front and profile photographs before and after operation.

[1] Read before the Surgical Section, New York Academy of Medicine, October 5, 1923, as part of a demonstration on "Plastic Surgery of the Face."

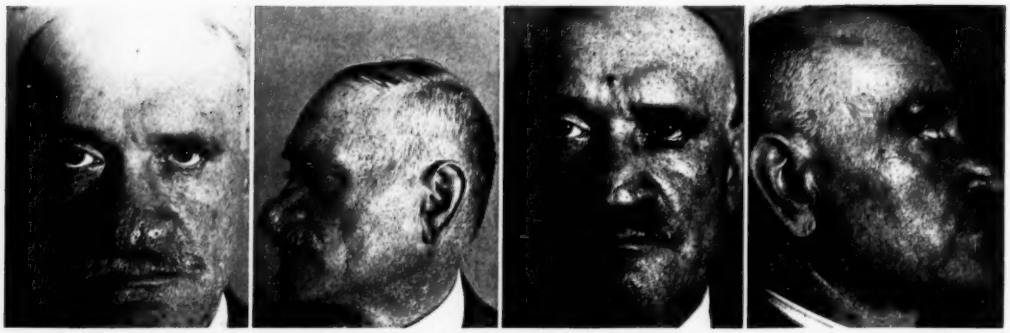


Fig. 2. Case 2, before and after operation.

laterally to the anterior borders of the alæ nasi. Chronic acneform lesions (comedones and sebaceous cysts) dotted the skin over the entire tumor surface and involved the skin of the rest of the nose and the adjacent parts of the cheeks. These lesions are evident in the illustrations. The skin of the tumor was leathery and firmly attached, but of normal color.

The photographs demonstrate the conditions before and after the operation and postoperative treatment:

Case 2. H. W., a man, aged 51, had had a growth on the nose for 10 years. It began as an ordinary acne rosacea which went on to a gradual hypertrophy of the sebaceous glands of the skin covering the nose and adjacent parts of the cheeks, gave a pebbled appearance to these areas, and resulted in a bilobular tumor of the tip of the nose and smaller tumors joining this from each ala.

Physical examination. Nothing of any importance was found except the growth which has been described sufficiently in the history and is better appreciated by consulting the photographs.

Case 3. J. H. B., man, age 62, dates the origin of the tumors of the bridge and tip of the nose 15 years back, when he first observed redness of skin. Careful study of the photographs shows that the acne rosacea involved the nose, cheeks, chin, and forehead.

Physical examination. Rhinophymata involved the bridge and lobule with extensive acne rosacea. Otherwise the examination was negative. After removal of the tumors surgically and after the completion of the skin-leveling process by the use of trichloracetic acid, the extensive rosacea responded readily to ¼ unit X-ray doses twice a month for 3 months. A comparison of the photographs shows the effect of the combined treatment. It will be noticed in the profile picture taken after operation that a ridge remained just above and forward of the right ala. The patient declared that he was satisfied with the general results and refused to take any further acid treatment. This is mentioned here to show that the patient is usually satisfied with the cosmetic effect before the surgeon.

Case 4. History. J. M., man, aged 68, had had the growth for 10 years. It started with an ordinary redness and thickening of the skin and developed over the period stated into a multilobular mass representing a 300 per cent enlargement of the lower half of the nose including both alæ and the tip and lower half of the anterior surface of the nose, the tumor fading off upward into a thickened ridge of skin overlying the bony ridge. Further attempt to describe this tumor would simply complicate matters, so the reader is referred to the photographs illustrating Case 4.

Note. The following interesting sidelight on this case is inserted. During the 10 years required for the gradual development of this unsightly mass of tissue upon the nose, the patient was also developing a cataract in either

Fig. 3. Case 3, before and after operation.

Fig. 4. Case 4, before and after operation.

eye which gradually deprived him of his vision. Bert Daly, who was good enough to refer this case, sent the patient to W. E. Lambert who removed the cataracts. The coloboma of either eye is plainly visible in the photographs. It was the return of vision that made the patient interested in the unsightly and disgusting appearance of his nasal deformity and caused him to seek relief, and thanks are due Dr. Lambert as indirectly responsible, through his skill as an eye surgeon, for the fact that the patient became interested sufficiently in his nasal disfiguration to accept operative relief.

Case 5. J. K., man,aged 59, noted the first change in the skin covering the nose 23 years prior to operation. The growth like all others was a gradual development and resulted in the forced retirement of the man from business and social life for a period of 8 years preceding the operation. The tumor as clearly shown in the pictures, was a tremendous mass consisting of 13 distinct lobulations resembling a bunch of grapes and hanging in a dependent manner from the thickened skin covering the bony bridge of the nose downward and laterally in a curved line drawn from either malar bone to the lower margin of the lower lip. This case also derives no justice from a verbal description and to save further attempts at this the photographs are inserted (Case 5).

Case 6. H. W. P., man, aged 57, with a history of gradual growth covering a period of 8 to 10 years, resulting in a tumor of bilobular form, also one smaller tumor on each ala. Patient gives a history of excessive use of alcohol and tobacco over a period of 15 years. The two tumors on the front of the nose were divided by a cleft running down to the level of the normal nasal lobule. This made the arrangement of the skin flaps for the reconstruction of the nose after the removal of the tumors very difficult, as the skin was of stiff, leathery consistency. However, after several attempts a satisfactory arrangement was made by proper shifting of the flap on the right side. The wounds healed by primary union and a nose of normal contour was obtained. The photographs (Case 6) show the result obtained in spite of the difficulty experienced in manipulating the flaps.

OPERATION

Preparation. After the catharsis and rest in bed for 12 hours and other specific preparations such as 25 per cent argyrol in the eyes, nostrils, and oral cavity, the skin of the face was cleansed three times with benzine, alcohol, and ether to remove the surface grease; and before the local anæsthesia was introdued 1 per cent iodine was used over the entire face and neck, and the face properly draped with sterile linen.

Fig. 5. Case 5, before and after operation.

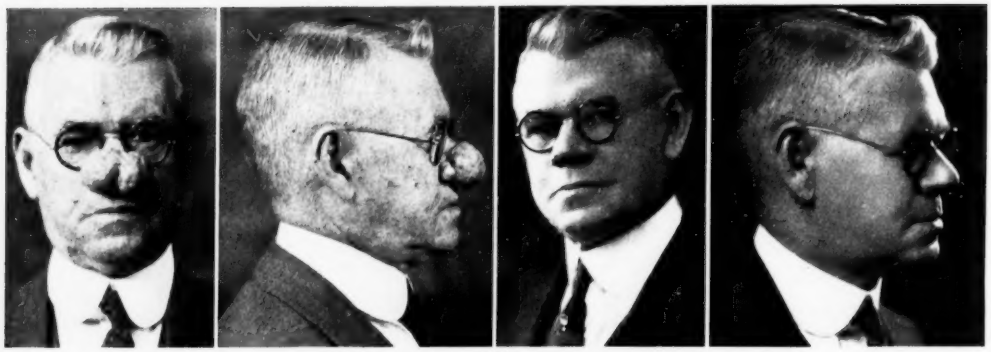


Fig. 6. Case 6, before and after operation.

Local anæsthesia. A 4 per cent sterile novocain solution was packed into either nostril on dental cotton rolls; 4 per cent novocain was injected around the nose beginning at the columella and extending laterally across the base of each nostril, along the outer border of either ala and upward from those points and across the middle of the nasal bones. To supplement this, the supra-orbital nerves and the middle branches of the trifacial nerves were blocked off at their emergence. The skin was infiltrated along the lines of excision of the separate masses of tumor tissue.

Operative technique. Curved incisions were made slightly above the line where each tumor mass began to show above the estimated level of what was intended to be the final level of the reconstructed nose. Enough skin from around the base of each tumor must be saved to cover the raw areas left after excision of the mass.

Reconstruction of the nose. In each case more than ample skin remained for covering the areas left by the excisions of the tumors, and after being trimmed the skin edges could be approximated and sutured without tension.

Dressing. One per cent iodine in glycerine was painted over the suture line and aristol powder was dusted over the entire nose. Vaselined gauze was applied and dry gauze over that with adhesive straps.

The average hospital stay was 3 to 4 days. Complete healing occurred in all cases within 10 days; the sutures were removed within that period as indicated, by loosening.

X-ray and acid treatments. After two X-ray treatments of ½ unit at weekly intervals, including ¼ unit each time to the entire face to clear up the remains of the general acne, 50 per cent trichloracetic acid was applied to the elevated areas at the end of the third week. The scabbing from this application usually required 6 to 7 days for completion. A pink area remained after the scab separated itself, for about 4 to 5 days. This was replaced by the normal color. Subsequent repetitions of the X-ray and the acid application were guided by the necessity of the case in each instance. The entire time required for the elimination of the irregularities and the scars of the operation varied from 3 to 5 months. When the patient was willing to continue until a practically ideal condition of the skin of both the nose and the face was obtained, this period was extended. The good effects of this persistence is illustrated in the photographs of Cases 1 and 3.

SUMMARY

1. Rhinophyma is a condition curable by surgery, X-ray and trichloracetic acid (triple technique).

2. The older technique of decortication and skin grafting from distant points seems no longer necessary and does not give the satisfactory results illustrated by the 6 cases outlined.

3. The disfigurement due to these growths is a personal, social, and physical handicap to the unfortunate patient and the one suffering with such deformity deserves to have the benefit of a radical attempt at elimination of the growth.

4. Gradual destruction of rhinophyma by the high frequency current seems a laborious task for both patient and operator as compared with the results of the surgical technique.

5. The use of flaps, demonstrated in the 6 cases herein described, gives a satisfactory primary result, without necessity of secondary skin-grafting.

6. The postoperative use of the X-ray and trichloracetic acid reduced the irregularities of the skin and rendered the operative scars practically invisible.

UMBILICAL ARTIFICIAL ANUS

By A. L. SORESI, M.D., New York
Visiting Surgeon, Greenpoint Hospital, Brooklyn

FAST rules cannot be laid down regarding any surgical procedure, and while the left iliac region has been the chosen location for a permanent artificial anus, it seems to me that, in properly selected cases, the umbilical region is a more suitable location. My clinical experience in using this region is limited to two early cases, one of which was operated upon with satisfactory results at the Greenpoint Hospital during the latter part of October, 1924.

When the umbilicus itself is dissected away, the umbilical region presents a roundish shape which conforms to the contour of the bowels and forms a well fitting receptacle for the implantation of the bowel. The fact that the umbilical region is located in the middle of the abdomen and presents a natural depression makes the wearing of a protective apparatus very effectual and comfortable; to appreciate this one need but recall how difficult and uncomfortable it is to hold any protecting device to the curves of the iliac region.

The greatest advantage of this region for an artificial anus, however, I believe lies in the practically perfect control of the passage of fæces. This control is obtained by surrounding the artificial anus with uninjured muscular fibers from the borders of both recti muscles, in such a manner as to constitute an effective sphincter. We emphasize the importance of surrounding the bowel with uninjured muscular fibers, because in any other procedure the muscular fibers that surround the bowel are split, torn or cut, consequently the blood and nerve supply of the muscular fibers are certainly more or less damaged, thus rendering the muscles less efficient. In the method proposed the muscular fibers that surround the bowels on all sides are absolutely uninjured and therefore completely efficient.

The technique used is as follows: The umbilicus is dissected away by an elliptical incision, following the line shown in Figure 1. This incision removes about 3 or 4 millimeters of superficial fascia all around the umbilicus, leaving exposed a corresponding amount of the muscular fibers of the external borders of both recti muscles. On the linea alba (Fig. 2) for 1 centimeter above and 1 centimeter below the umbilicus, the external borders of both recti muscles are also exposed. This is done by splitting the linea alba and removing about 3 or 4 millimeters of the superficial fascia as was done around the umbilicus. The deep fascia and the peritoneum are cut close to the external borders of the recti muscles. The end of the bowel is passed through the opening resulting from the dissecting of the umbilicus, and allowed to protrude a few millimeters. The peritoneum and the posterior fascia of the recti muscles, with all its structures that surround the umbilical region are secured to the serosa of the bowel with a continuous mattress suture made with catgut No. 0 or 1. Care must be taken to evert well the peritoneum so that it is properly approximated to the serosa of the intestine. A second continuous suture made also with catgut No. 0 or 1 secures the external fascia of the recti muscles to the serosa of the intestine. A third row of continuous suture approximates the skin to the bowel. Care must be taken to preserve the blood supply to the mucosa. Therefore, these sutures should be very superficial, the needle entering only the serosa and muscularis, respecting the submucosa and the mucosa. The two incisions made on the linea alba above and below the umbilicus are also closed with three rows of sutures. The deep suture approximates the peritoneum and the deep fascia. The middle suture approximates the superficial fasciæ of both recti. The external suture approximates the skin.

The bowel should fit closely and snugly around the edges of the recti muscles (Fig. 4). Attention is called to the special manner of incising the superficial fascia away 3 or 4 millimeters from the external borders of the recti muscles. By so doing and suturing the superficial fascia to the bowel, the muscles are forced to bulge around the bowel and thus form an efficient sphincter. The bowel

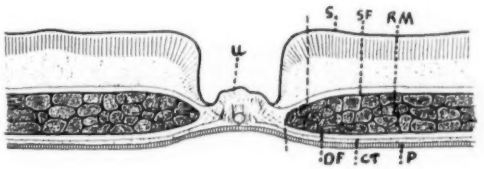


Fig. 1. Umbilical region showing line of incision, which should remove about 3 or 4 millimeters of the superficial fascia all around the umbilicus. *S.*, Skin; *S. F.*, superficial fascia; *R. M.*, rectus muscles; *D. F.*, deep fascia; *C. T.*, cellular tissue; *P.*, peritoneum; *U.*, umbilicus. (from Testut et Jacob, anatomie topographique.)

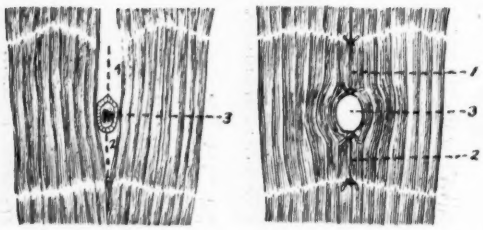


Fig. 2. Umbilical region, superficial fascia having been removed, with incisions on the linea alba, about 1 centimeter long above and below the umbilicus. *1* and *2*. Linea alba above and below.

3. Umbilicus, showing line of incisions about 1 centimeter long.

Fig. 3. Schematic view showing how muscular fibers should surround the bowel on all sides. Stitches are shown as entering the muscular fibers. This is done to show how the sutures should approximate the muscular fibers to the bowel. *Sutures, however, must not enter the muscular fibers, but only the fasciæ*. *1* and *2*, Linea alba removed, close approximation of muscular fibers to, *3*, bowel.

should fit rather snugly around the surrounding tissue, just as does the natural anus.

It is necessary to emphasize that the sutures should enter only the peritoneum and the deep and superficial fasciæ, never the muscular fibers. Also, when the peritoneum is being sutured to the intestine, deep fascia *must be included*. If the deep fascia is not included, the muscular fibers will not be in close contact with the intestine and the sphincteric action will be hampered by the formation of an excessive amount of connective tissue. The muscular fibers must surround the bowel (Fig. 3) on all sides and be held in position only by the fasciæ to which they are attached and their vitality and efficiency should not be hampered by sutures or excessive connective tissue.

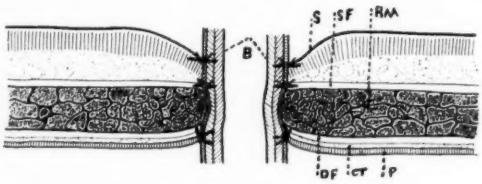


Fig. 4. Cross view of umbilical artificial anus, showing the 3 rows of sutures. Note how muscular fibers bulge against bowel. *S.*, Skin. *S. F.*, *R. M.*, *D. F.*, *C. T.*, *P.*, as in Figure 1. *B.*, Bowel.

We do not enter into any details of surgical technique indispensable to the establishment of an artificial anus and therefore familiar to all good surgeons. We shall, however, remark that the longer the loop of colon behind the new anus, the better. Also that the loop of intestine must be free from any tension. To obtain a free loop at times it might be advisable to free the colon from the parietal peritoneum.

CONCLUSIONS

I believe that the umbilical region presents many advantages over any other for the location of a permanent artificial anus on account of its superior sphincteric action and the comfort which results from adapting to this region a protective device.

We do not claim that an artificial anus located at the umbilical region is a blessing, because, at the best, an artificial anus is always little less than a curse. We think, however, that it is our duty as surgeons to strive to make this necessary evil as little damnable as possible by giving the patient the benefit of any ingenious device we can conceive for his comfort.

AN ADJUSTABLE SPLINT

By I. R. SMITH, M.B. (Tor.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), Toronto, Canada

THE following is the description of a splint which I have used on the western front with satisfactory results. It will hold firmly long bones that have been fractured or joints which are to be maintained in a set position for rest.

The splint consists of rods connected by means of an elastic medium such as straps of rubber webbing. This webbing permits the splint as a whole to conform snugly to the various contours of the limb or joint, and therefore at the same time exerts the required amount of pressure upon the parts treated. It is simple in construction and may be removed without causing disturbance of the parts, and any number of splint rods may be carried conveniently in a roll. The desired number of connecting rods may be separated from the roll by cutting through the elastic medium, thus giving the width; and the required length is secured by cutting the rods.

Figure 1 shows the splints spread out flat. The detail of the construction may be readily understood from this drawing.

Figure 2 represents a side view partly in section of one of the splint rods and the elastic connecting strip shown in Figure 1.

Figure 3 is an end view of a series of splint rods such as those shown in Figure 1.

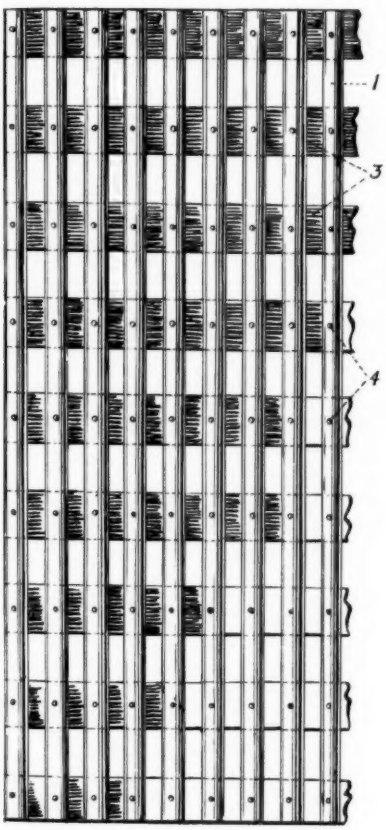


Fig. 1.

Fig. 2.

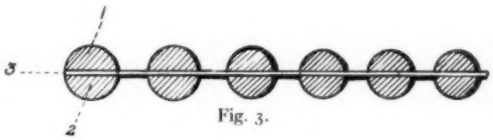


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

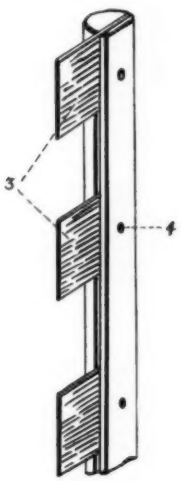


Fig. 7.

Figures 4 and 5 are similar views showing the individual splint rods of modified configuration.

Figure 6 illustrates on an enlarged scale one of the splint rods similar to the splint rods shown in Figure 2, but made in one piece with the transverse apertures provided for the reception of the elastic medium to connect the rods.

Figure 7 is a perspective view of the modified form shown in Figure 4.

DETAILED DESCRIPTION OF CONSTRUCTION

Like reference numerals indicate like parts in all these drawings.

In the drawings, *1* represents a longitudinally extending rounded half section of a splint rod which may be made either of cane, wood, or other flexible material; *2* represents a similar oppositely located section; *3* represents the elastic medium such as the rubber strap located between sections *1* and *2*. The rods forming these sections may be made of any desired length and the elastic medium of any desired width since it may be found convenient to support any number or lengths of splint rods.

In the construction shown, *4* represents rivets which can be used for additional strengthening of the elastic medium to the splint rods.

In Figure 1, *4* represents pins or rivets passing through the rod section *1*, the elastic medium, *3*, and the opposite rod section, *2*, whereby these sections are held together in proper position relative to the elastic medium, *3*.

In the drawings the rod sections, *1* and *2*, are made of cane rods split through the center, cane being very desirable for its longitudinal elasticity whereby it may readily assume the contour of the part to which it is applied.

In the modification shown in Figure 6, *5* represents a series of hoops which are formed by cutting or mortising through the center of the cane rods, and the elastic bands in this drawing are passed through these hoops and may be fastened in place by pins or rivets similar to the rivets, *4*. Or if preferable the parts may be secured in position by gluing or cementing the elastic bands within these hoops, or if desired the individual splint rods may be mounted slidable on the elastic straps so that an increased number of rods may be applied to a given area. In the construction shown in Figures 1, 2, 3, 4, 5, and 7 the elastic bands or straps will be secured between the cane sections either by gluing or cementing them there or by means of pins or rivets.

METHOD OF APPLICATION

In the modified form of splint rods shown in Figures 4 and 7 it will be noted that only one of the rounded sections of the cane rods is used, and that an elastic medium is held between its flat face and the face of a flat thin strip of wood. These three elements may be united by applying cement or glue upon the surface engaging the elastic medium, or may be united as shown in Figure 7 by pin or rivet.

Figure 5 is an embodiment of a splint with rods which are square. The details of the splint will be readily understood from the drawings and, therefore, do not require any more detailed description.

In applying this splint, as before stated it may be conveniently made in great widths and a portion of any required width or length sufficient for a particular part to be treated may be separated from the main portion by cutting longitudinally enough for the main portion.

The limb is first prepared and well padded with absorbent cotton and the splint is drawn taut around the limb, distending the elastic medium. When the splint is in position, an adhesive strap is wound over the splint rods to retain them in their extended fixed position. The longitudinal flexibility of the splint rods would, of course, respond to the particular outline of the limb. The elasticity of the straps, *3*, permits the accommodation of the rods to the stouter or enlarged portion of the limb to be treated, so that throughout its length it snugly fits the limb just like a plaster-of-Paris cast.

NOTES ON THE DAVIS AND CUSHING METHOD OF SALVAGING BLOOD DURING MAJOR INTRACRANIAL OPERATIONS

By E. VERNON HAHN, M.D., Indianapolis
Instructor in Surgery, Indiana University School of Medicine

THE great importance of having a therapeutic measure at hand for the treatment of exsanguination and shock during and after intracranial operations is universally admitted. It is also axiomatic that restoration of blood volume and replenishment of blood corpuscles are the only known means of meeting the indications in many cases. The difficulties of obtaining compatible blood and of effecting its transfer to the patient make the method reported by Davis and Cushing[1] a welcome addition to our armamentarium in all sanguinary operations in which uncontaminated blood may be collected.

In brief, the Davis and Cushing method consists of aspirating blood from the field of operation through a glass tube connected by a rubber tube with a collecting flask which is continuously evacuated of part of its air by means of a water pump ("filter pump"). The aspirating tube is frequently dipped into 2 per cent sodium citrate solution to prevent clotting of the collected blood. At any time during the operation or after it, the salvaged citrated blood may be employed as an intravenous infusion. The cases reported by Davis and Cushing in which this method was employed indicate convincingly that the procedure is both safe and effective.

A particular feature of the method in question which endows it with unique value is its expeditiousness. The fluid for transfusion accumulates as the patient's need for it grows and it is ready in emergency without the delays inevitable in obtaining blood from a donor even though he be waiting in the operating room.

I read the Davis and Cushing paper in time to attempt the application of this method in an exploration of the middle cerebral fossa for a tumor of the left gasserian ganglion. At the conclusion of the operation, the condition of the patient was excellent and it was considered unwise to subject him to the added risk, small though it was, of injecting the collected citrate-diluted blood. However, 300 cubic centimeters of rich diluted blood had been collected which might have been employed to tremendous advantage had the circumstances warranted.

[1] Davis, L. E., and Cushing, H. Experience with blood replacement during or after major intracranial operations. Surg., Gynec. & Obst., 1925, xl, 310-322.

In this experience, I employed a slightly different arrangement of apparatus and further changes have occurred to me which I wish to embody in this paper as suggestions.

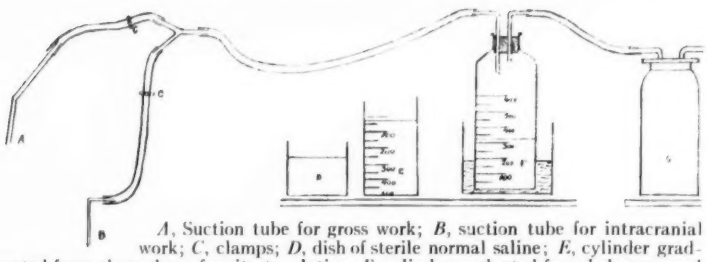
Instead of the water suction pump, the usual Brophy suction apparatus gave good service in my case. The collecting bottle of the Brophy apparatus was employed as a safety bottle, standing between the pump and the blood-collecting bottle. Had the motor stopped accidentally, oil or water from the pump which might have been sucked back into the partly evacuated collecting bottle would have been caught by the safety bottle.

Another change was in providing the collecting bottle with a Y tube so that two aspirating tubes might be carried to the operating table. One of these was connected with a suction tube of glass, 4 millimeters in diameter for use in the gross work of entering the skull. The other tube was attached to a much more delicate glass tube which was bent at right angles and used to aspirate the depths of the middle fossa. Each rubber tube was provided with a clamp so that the one not in use could be occluded.

In previous operations in the middle fossa (for sensory root resection in major trigeminal neuralgia) the author has had considerable difficulty in maintaining a dry field. Especially when a leak of cerebrospinal fluid occurred, or when much hæmorrhage was encountered, the procedures for a time were submarine, so to speak. On this last occasion, the suction apparatus functioned admirably and the region of the ganglion was at all times in plain view. Sponging was only occasionally necessary. The narrow glass suction tube did not become occluded by clot.

The larger suction tube worked equally well during the procedures on the parieties. A more rapid technique was made possible by substituting suction for sponging. At the same time, the field was cleaner and the clamping of bleeding arteries was facilitated because the field was not concealed half the time, as it usually is, by the assistant's sponge.

At the conclusion of the operation, the question arose as to the probable percentage of sodium citrate in the collected fluid. This, we were able to estimate only roughly. The author therefore



A, Suction tube for gross work; *B*, suction tube for intracranial work; *C*, clamps; *D*, dish of sterile normal saline; *E*, cylinder graduated from above down for citrate solution; *F*, cylinder graduated from below upward for collected blood; *G*, safety bottle; *G*, collecting jar of Brophy apparatus.

suggests that the collecting bottle be cylindrical and graduated and that the citrate solution be kept in a similar vessel. By dividing the volume of the collected fluid into the volume of citrate solution used, the percentage of sodium citrate in the diluted blood can readily be obtained. An extra assistant or a nurse could make this simple calculation at intervals and advise the operator of the exact concentration of citrate in the collected fluid. The concentration of sodium citrate could be kept below some maximum value by employing normal saline solution when it became desirable merely to flush the tubes mechanically. No record need be kept of the volume of normal saline.

In view of accumulated experience in blood transfusion, and inasmuch as the fluid is filtered free of small clots before its injection, a concentration of 0.7 per cent of sodium citrate should be adequate. In a 500 cubic centimeter transfusion, the dose of citrate would thus be well under the toxic limit.

If the blood collecting bottle is kept in plain view of the surgeon, upon a side table, rather than under the operating table as described in the Davis and Cushing paper, a quite accurate knowledge of the amount of hæmorrhage is at all times available to the surgeon without his asking any questions.

Both the changes in apparatus which the author employed and those he has the temerity to propose are embodied in the sketch. Following is a very brief report of my case. Full details of the pathological findings will appear in another paper.

Case report. The patient was a 59-year-old policeman who was injured 3 years ago upon the left side of the head. A stone was thrown from a distance of more than a hundred feet, striking him in the temporal region. There were no immediate disabilities. A year ago he began to experience numbness of the left mandibular region of the face including the teeth and gums. A little later pain in the left temporal and supra-auricular region became severe. Then his eyes began to fail. On examination there was found a bilateral choked disk, more extreme on the left; anæsthesia of a large part of the trigeminal distribution; and a slight palsy of the left fourth nerve. A diagnosis of tumor of or near the left gasserian ganglion was made. After the temporal approach had been completed and the dura elevated, a tumor mass was exposed lying under the ganglion, continuous with its under surface, and lying behind the third division of the fifth nerve. This mass was removed piecemeal. Included with the friable but firm tissue were nerve fibers. The sixth nerve was not seen during the dissection as a discrete separate structure. The pathological report on the tissue was endothelioma of the gasserian ganglion. Postoperative recovery was satisfactory. The patient is now ambulatory and able to read. The choked disk of the right eye has entirely subsided. On the left, there is no swelling of the nerve head but there is an intense optic neuritis and practically no vision. The pain and the fourth nerve palsy are entirely relieved but there is complete paralysis of the external rectus and the anæsthesia is the same as before operation.

CONCLUSIONS

1. Suction methods are an improvement over sponging in intracranial operations.
2. Blood may be recovered and citrated for use in relieving operative shock and exsanguination.
3. The use of a graduated collecting vessel is suggested as a possible improvement in the method of Davis and Cushing.
4. A case of endothelioma of the gasserian ganglion is briefly reported.

A VISUAL PROSTATIC PUNCH[1]

By D. K. ROSE, M.D., St. Louis, Missouri

SINCE the Hugh H. Young prostatic punch (1909) several modifications both of principle and mechanics have been brought forth: the Young cautery punch of 1911; the J. R. Caulk cautery punch of 1920; and the Geraghty sphincterotome of 1922. In no case, however, has an attempt been made to prevent hæmorrhage by cauterization with a visual instrument, so that several punches from the prostatic orifice can be made at one sitting, and all under direct, and so selective, vision. These important factors are accomplished with the instrument described.

First, the instrument affords vision by having a large, oval, single sheath for cutting and cauterizing, which can carry illumination throughout its length. Second, it provides hæmostasis by cauterizing with an electrically heated platinum plate which immediately follows the cutting (steel) knife. The knife, cauterizing plate, and its conduction wire are a part of, or incorporated in, the narrow sliding portion of the sheath, which is controlled by a thumb ring fastened to an ebony asbestos and steel plate, placed at right angles to the shaft. The ease of cutting with a sharp blade renders unnecessary any other than thumb pressure, which is applied at a point well out of line of vision. The first cylinders of prostatic tissue are removed with long forceps or pushed up into the hollow tip with a long wood applicator. A 110 alternating current is used for heating the cautery.

Success in overcoming the mechanical difficulties of this instrument is largely due to R. H. Tontrup, instrument maker, St. Louis.

[1]From the Department of Surgery, Washington University School of Medicine, St. Louis.

MEMOIRS

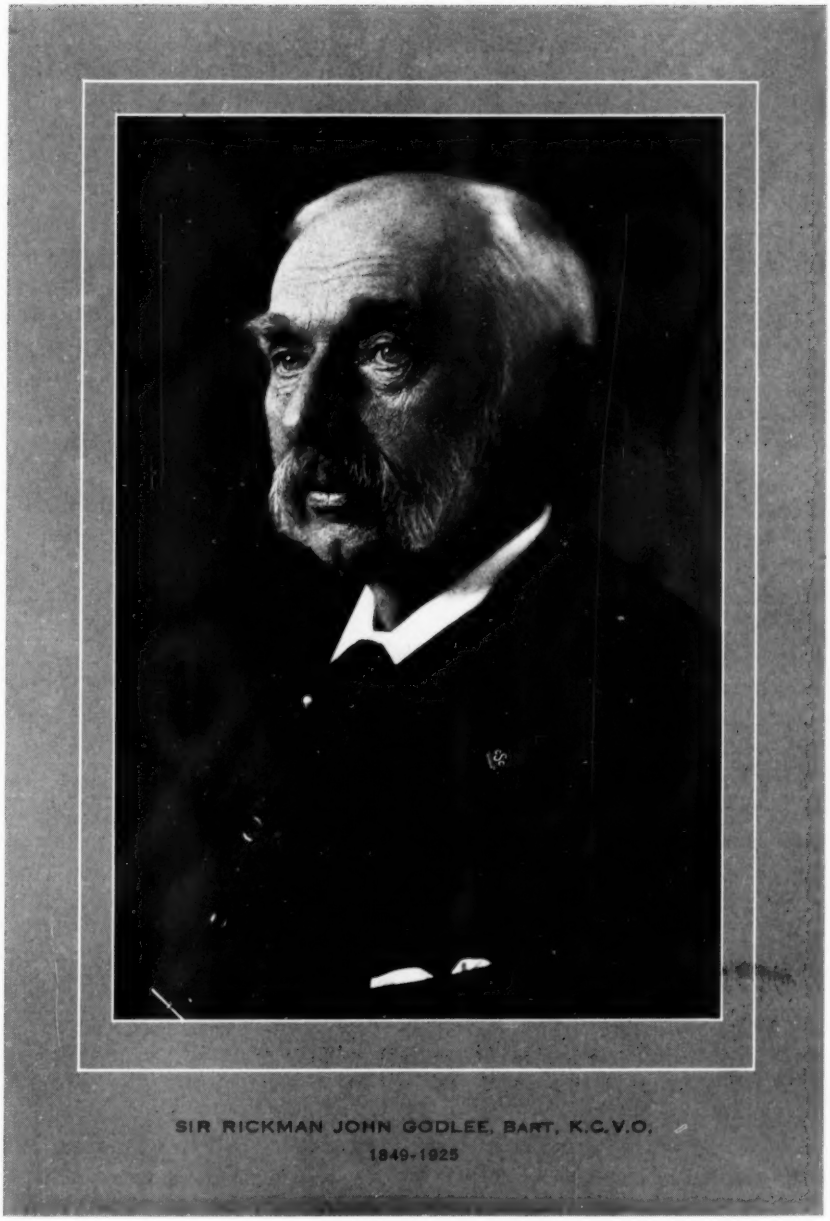
SIR RICKMAN GODLEE

SIR RICKMAN GODLEE, the godfather of the American College of Surgeons, an ex-president of the Royal College of Surgeons of England, authorized biographer of Lord Lister, and a surgeon of international reputation, died at Coombe End Farm, Whitchurch, Oxon., England, on Sunday night, April 19, 1925. Until within two hours of his death he was apparently in perfect health, and for a man seventy-six years of age he was unusually vigorous and active.

Doctor and Mrs. Franklin H. Martin, close friends of Sir Rickman and Lady Godlee since their journey to Chicago to represent the Royal College of Surgeons of England at the first Convocation of the American College of Surgeons, went to Whitchurch to spend the week-end of April 18 at Coombe End Farm. Sir Rickman and Lady Godlee met their guests at the station at Pangbourne on Saturday afternoon. Saturday and Sunday, two delightful days, were given to motoring in the country about Oxford, punting on the Thames that flows within sight of Coombe End Farm, examining the operations on the farm, long walks about the country, and in social intercourse in and about the cozy country home.

On Sunday afternoon, Sir Rickman complained of gastric pain, and Dr. Leslie, the family doctor, was called. In the course of the examination, a pulsating tumor was located slightly to the left of the middle abdomen. Sir Rickman remarked that some specialist, in going over him within the year, had pronounced this as a probable aneurism. Dr. Leslie, however, could trace no direct connection between this pulsating tumor and the gastric distress, and as the condition of the patient did not seem serious, he was given a sedative and the incident passed over as an unimportant temporary indisposition. At eleven thirty o'clock Sunday evening, Dr. Martin was called. Sir Rickman was found to be in a dying condition. Five minutes before he had cried: "Something has given way." He was in great distress, pulseless, and there was evidence of profound shock with symptoms of acute internal hæmorrhage. He immediately lapsed into unconsciousness, and before twelve o'clock he was dead. The cause of death was given by Dr. Leslie as aortic aneurism. There was no autopsy.

On Thursday afternoon, April 23, the oaken casket which contained the remains of Sir Rickman was borne to the little English church at Whitchurch on the shoulders of eight young men among whom he had lived in the country, and by



SIR RICKMAN JOHN GODLEE, BART, K.C.V.O.
1849-1925

whom he was loved and respected. A special train from London carried to the funeral Sir Rickman's many lifelong friends, his official associates, and representatives of his King, all of whom paid silent tribute to a great man and a friend. The services were very simple, with the local Rector and choir attending. He was laid to rest in a grave under the cedars in the adjoining churchyard.

Sir Rickman Godlee, in his official capacity as president of the Royal College of Surgeons of England, did a great service to American surgery when he volunteered, in behalf of his time-honored organization, to act as official sponsor and orator at the first Convocation of the American College of Surgeons, November 13, 1913. During his visit there developed on his part a personal friendship for our College, our journal, our Clinical Congress, and for a host of their individual members; and this friendship was reciprocated. In a long walk on the morning of the day of his death, he discusssed with enthusiasm our American institutions, and asked after the personal welfare of many individual surgeons whom he had learned to know and admire, and who were his friends in America.

Sir Rickman was as generous as he was great in usefulness and in influence. In his last moments of consciousness, although he was in great agony, his concern was that his death, which he recognized as being near, would be an inconvenience to us, his friends, and that his suffering would give pain to his life's companion, whom he loved and who loved him.

The following biographical sketch is an abstract of an obituary notice which appeared in the April 21 issue of *The London Times*.

Sir Rickman Godlee, Bt., came of an old Quaker family, being the second son of Rickman Godlee, a well-known barrister of the Middle Temple, by Mary, daughter of Joseph Jackson Lister, the father of Lord Lister. He was thus a nephew of the great surgeon whose life he wrote, and a cousin of Marcus Beck, who influenced for good several generations of medical students at University College Hospital, where he was surgeon and a great teacher of surgery. Rickman Godlee was born at Upton, Essex, on February 15, 1849, and was brought up amongst those surroundings of a well-to-do Quaker family which he afterwards described so graphically in his life of Lord Lister. He was educated at a school at Tottenham, and took his B.A. degree at the University of London in 1867.

Entering at University College, he soon proved himself a most expert dissector. He was admitted a member of the Royal College of Surgeons in 1872, and was elected to the fellowship in 1876, having in the interval taken the degrees of B.S. and M.S. at the London University after winning the gold medal at each examination. He was house surgeon and house physician at University College Hospital, and then went to Edinburgh to learn the new methods which were being introduced into surgery by his uncle. On his return to London he was appointed surgical registrar at University College Hospital, and was elected assistant surgeon at Charing Cross Hospital and North-Eastern Hospital for Children. In 1877 he

was elected assistant surgeon at University College Hospital, and was appointed assistant demonstrator of anatomy in the medical school. Soon afterward he became surgeon to Brompton Hospital, where he made important advances in surgery of the chest.

At the Epileptic Hospital in Regent's Park, Godlee performed one of the earliest operations for the removal of a tumor from the brain, the position of the tumor having been previously ascertained by employing the method evolved by Sir David Ferrier in experiments.

At University College Hospital, Godlee became surgeon, consulting surgeon, and eventually emeritus professor of clinical surgery. At the Royal College of Surgeons he filled all the usual offices, including that of examiner in anatomy and membership on the court of examiners, until he was elected president for the years 1911–13, in succession to Sir Henry Butlin, who died during his tenure of office. He was surgeon to the household of Queen Victoria, and was surgeon in ordinary to King Edward VII, and to King George V. He was created a baronet in 1912, and was gazetted K.C.V.O. in 1914. He married, in 1891, Juliet Mary, daughter of Frederic Seebohm, LL.D., D.Lit., of The Hermitage, Hitchin, but had no children. After his retirement from London in 1920 he went to live at Coombe End Farm, Whitchurch, Oxon., where he died.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.....Managing Editor
ALLEN B. KANAVEL, M.D..... Associate Editor

WILLIAM J. MAYO, M.D.....Chief of Editorial Staff

JULY, 1925

UROGRAPHY

THE term "urography" is used to indicate the roentgen-ray examination of the various divisions of the urinary tract which have been rendered opaque by the various mediums. The present widespread employment of urography as an aid in the diagnosis of surgical conditions involving the urinary tract merits careful consideration of its use, as well as its limitations. Although the method was first successfully brought out by Voelker and von Lichtenberg in 1906, it is only within the last eight or ten years that its clinical value has been recognized, and that its use has become general. Probably the greatest factors in bringing this about were the employment of comparatively harmless mediums, standardization of technique, and wider familiarity through pyelographic interpretation. With the employment of the halogens as a pyelographic medium, much of the danger attending pyelography was eliminated. In 1918 an aqueous solution of sodium or potassium iodide was suggested by Cameron; subsequently a solution of potassium iodide by Rubritius, and of sodium bromide by Weld. These solutions were at first employed in a concentration of 25 per cent, but it was later found that a 12 per cent solution of sodium iodide and a 15 per cent solution of sodium bromide give a satisfactory outline, and cause less local irritation than the more concentrated solutions. As to the choice of a medium, the fact that sodium-iodide solution is isotonic to the tissues in lesser concentration than sodium bromide, and is consequently less irritating when retained in the renal pelvis, probably makes the former preferable.

As a medium for cystography, the halogens are not quite as satisfactory, since they cause considerable local irritation when the mucosa of the bladder is inflamed. Suspensions of iodide in an oil base, and silver iodine emulsion, 5 per cent, have proved to be satisfactory and are doubly useful in the bladder, in that they are therapeutic as well as diagnostic. Air inflation has also been employed for this purpose, but is not always satisfactory, since it causes pain when the bladder is over-distended, and occasionally extensive emphysema of the tissues.

Probably the most essential technical precaution is against over-distending the renal pelvis. It really does not make much difference whether the medium is injected by a hand syringe or by gravity, if ordinary care is used and the injection is stopped as soon as the patient complains of discomfort. It is obvious that the medium employed should be sterile; the sterilization can be accomplished by dissolving 1 gram of mercuric iodide in 3,000 cubic centimeters of 12 per cent sodium iodide. A comparatively small ureteral catheter is preferable, because it permits return flow into the ureter in case of pelvic over-

distention. The catheter should be left in place for a few minutes after injection, to permit the medium to drain from the pelvis.

It should be emphasized that, in spite of an ideal medium and every technical precaution, urography should not be a routine procedure. There are definite contra-indications to its use, such as (1) the age or great emaciation of the patient, (2) advanced bilateral renal disease, and (3) the apparent lack of benefit from surgical treatment. The general rule that no instrumentation should be employed in the urinary tract, which is not necessary to complete a diagnosis, should be strictly observed. Doubtless urography is being frequently employed unnecessarily. It should not be employed merely to corroborate a diagnosis which can be readily made without its use, such as evident hydronephrosis, renal stone or renal tumor.

It should be recognized, moreover, that urography is not without some danger to the patient. When the injected medium is retained in the renal pelvis, it may be absorbed into the renal tissue and might occasionally cause acute renal infection. Retention of pyelographic mediums may occur with pyelectasis from any cause, and particularly with occluding ureteral stone, polycystic kidney and renal neoplasm. When there is any clinical or cystoscopic evidence suggestive of these lesions, it is advisable to leave the ureteral catheter in position for an hour or more, to insure thorough drainage of the pelvis, and then to institute lavage with sterile water. If, in spite of this precaution, clinical evidence of acute renal infection should develop, surgical intervention should not be delayed. Fortunately, with the employment of the various technical precautions, such complications will seldom occur. However, the possibility precludes the routine use of bilateral pyelography.

The suggestion of rendering the urinary tract opaque by means of sodium iodide injected intravenously, which was made recently by Rowntree and associates, is still in the experimental stage. While the principle involved is one of fundamental importance, and may offer much for the future, nevertheless, with the present methods, the renal pelvic outline is not sufficiently clear to be of much value in interpretation. The outline of the bladder has frequently proved to be more accurate and the method may be applicable in those cases in which the passage of a catheter in order to make a cystogram would be inadvisable. For this purpose the oral administration of iodides in moderate dosage may be sufficient.

Because of the difficulties involved in the application of urography, it should be used only by physicians who are thoroughly familiar with the technique. However, its clinical value is such that it will undoubtedly be increasingly employed. WILLIAM F. BRAASCH.

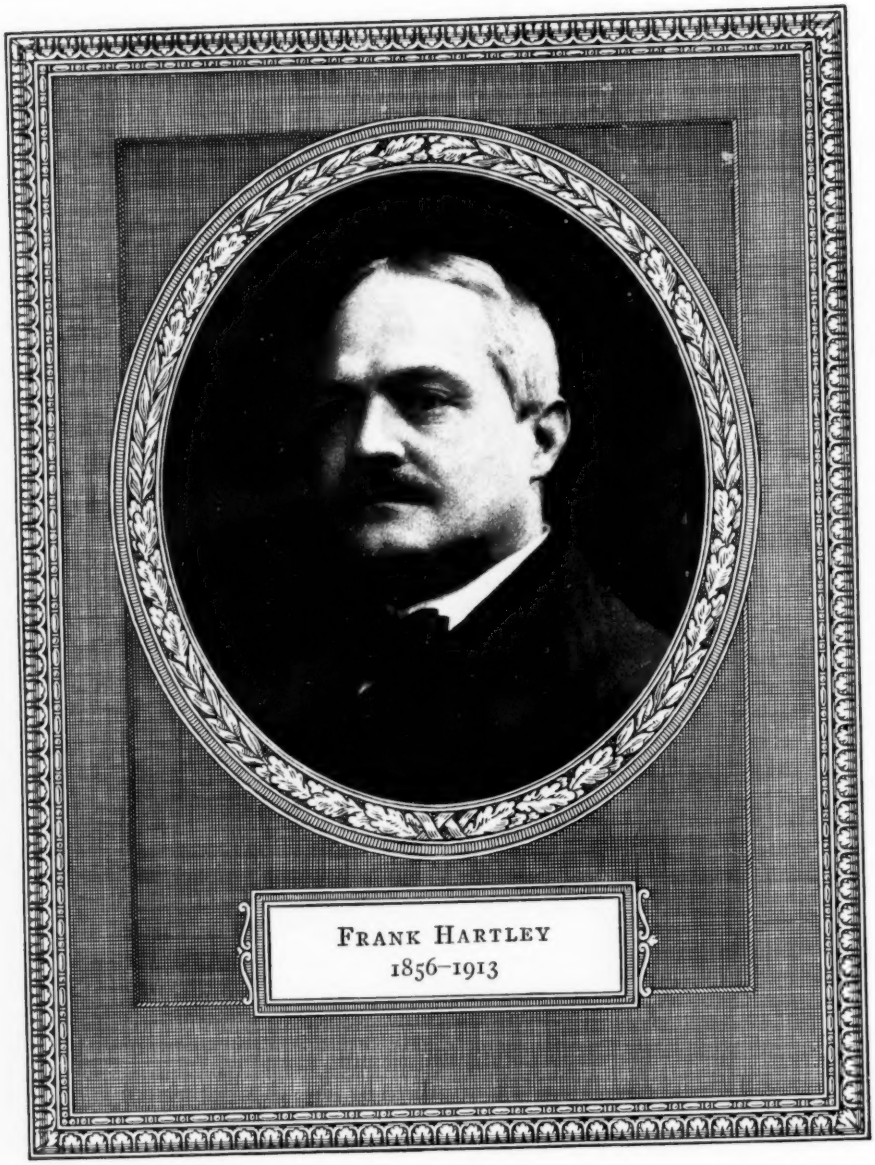
THE FORAMEN OF WINSLOW

THE foramen of Winslow is formed by the rotation of the primitive stomach and connects the retrogastric space, or lesser peritoneal sac, with the greater peritoneal cavity. It is normally about 8 centimeters in circumference, enough to admit two fingers. It is particularly useful to the surgeon in palpating the common duct and other structures in the immediate vicinity. If one could speak of its having any function, it would be only as an outlet for peritoneal fluid formed in the lesser sac. The condition of hydrops saccatus—a collection of free fluid in the lesser peritoneal sac—appears to be very rare, probably because the foramen of Winslow is usually open and also because the absorbing power of the upper peritoneum is greater than that of the lower.

The statement is made in many textbooks that the foramen of Winslow is often closed and it seemed worth while to investigate the accuracy of it. For the past 5 years we have noted the condition of the foramen in nearly all of our laparotomies where an exploration of the upper abdomen was justified. During that time we have found the Winslow closed in 18 cases in approximately 700 laparotomies —about 2½ per cent. It is interesting to note that in 17 of those cases where the foramen was closed, the gall bladder was diseased—in the remaining 1 case there was a carcinoma of the cæcum with intussusception. We have gone over the records of the last 109 cases in which laparotomy was performed for upper abdominal conditions. The foramen was found closed in 13 cases, approximately 12 per cent, while it was patent in 96 cases. However, of these 96 cases, more or less dense adhesions in and about the foramen were noted in 43 cases. In view of the fact that the anterior and posterior margins of the foramen are normally quite close to each other, it seems surprising that it is not more often sealed by adhesive inflammation. The infrequency of hernia through the foramen of Winslow is readily explainable by the anatomical disposition of the small intestines and the usual fixation of the hepatic flexure of the colon.

Our conclusion, based on the material we have studied, is that the foramen is seldom closed except as the result of gall-bladder disease.

WALLACE I. TERRY.



FRANK HARTLEY
1856–1913

MASTER SURGEONS OF AMERICA

FRANK HARTLEY

FRANK HARTLEY, surgeon, was born in Washington, D. C., June 10, 1856, son of John Fairfield and Mary D. (King) Hartley. His father was a lawyer, and for many years assistant secretary of the United States Treasury; his grandfather was Samuel Hartley, who, during the war of 1812, held a letter of marque from the United States government, and a commission as lieutenant in the Navy.

Dr. Hartley attended the Emerson Institute in Washington, and was graduated at Princeton College in 1877. He studied medicine at the College of Physicians and Surgeons, New York City, receiving his medical degree in 1880. For two years he was interne at Bellevue Hospital, and then took special courses at Heidelberg, Vienna, and Berlin universities.

Returning to New York in 1884, he was appointed assistant demonstrator of anatomy at the College of Physicians and Surgeons, and four years later became demonstrator. In the meantime, in 1886, he became visiting surgeon to Bellevue Hospital, and assistant visiting surgeon to Roosevelt Hospital, holding the former position for four years and the latter for thirteen. In 1890 he was appointed attending surgeon to the New York Hospital, and in 1893 consulting surgeon to the New York Skin and Cancer Hospital. He was also instructor in operative surgery on the cadaver at the College of Physicians and Surgeons from 1888 to 1900, and then became clinical professor of surgery. In the same year he became consulting surgeon to the French Hospital, New York; Nyack Hospital, Nyack, New York; and St. Joseph's Hospital, Paterson, New Jersey.

He was associated with Dr. Henry B. Sands in private practice, and was his assistant at the Roosevelt Hospital up to the time of Dr. Sands' death in 1888.

He was famed among his confrères for his unusual proficiency in anatomy and his bold and skillful operative technique. Even in the earlier years of his career as an operating surgeon, many difficult and hazardous surgical cases were referred to him as the one man who never shirked the responsibility involved, and who had the ability and courage to cope successfully with surgical problems from which the average operator would shrink. This became more and more noticeable in his later years for he held his place as the outstanding surgeon to whom physicians looked for help in their bad risk cases. Whether brilliant result or failure followed his effort, he was always ready to give the best that was in

him for the good of the patient, and his indomitable courage and fighting spirit combined with his consummate surgical skill carried many a desperate case through to a successful conclusion.

Though his operative activities were broad and general, he was especially interested in the surgery of the brain and nervous system, and attained great distinction in this field.

His most memorable contribution to medical literature was on the subject of trigeminal neuralgia. Intracranial resection of the gasserian ganglion was first suggested and performed by him for this disease, and the operation, but little modified, is now widely adopted. As Dr. Krause of Altona, Germany, independently performed the operation at about the same time it is generally known as the Hartley-Krause method.

Dr. Hartley wrote many monographs on surgical subjects. Among his papers are "Congenital Deformities of the Neck," "Early Operation in Appendicitis," "Thyroidectomy," "The Operative Treatment of Club-foot," and "Abdominal Echinococcus and Laminectomy."

He was a member of the New York Pathological, New York Surgical, New York Clinical, the New York Medical and Surgical, the American Medical, the American Gastro-Enterological, and American Urological Societies, as well as the University, New York Athletic, and Princeton clubs and the Southern Society. He was an enthusiastic lover of all forms of athletic sport. He was married August 1, 1897, to Emma Allyce Parker, daughter of George Burton and Mary (Granville), of Norfolk, England, who survived him. Princeton conferred upon him the degree of Doctor of Laws in 1909. He died in New York City, June 19, 1913.

CHARLES H. PECK.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 20, 1925, DR. CAREY CULBERTSON PRESIDING

ADENOCARCINOMA OCCURRING IN A PEDUNCULATED GROWTH

DR. HENRY SCHMITZ: On September 2, 1924, an O-para, aged 40 years, school teacher, was admitted to the Mercy Clinic. The only symptom she presented was a very profuse leucorrhœa, of 8 years' duration, which was at times blood-stained. On examination it was found that she had a large cauliflower growth which almost filled the entire vagina. The tissue was very friable. There was no infiltration of the left parametrium, but in the right parametrium was a very large mass the size of a man's fist, which was firmly fixed and of hard consistency. On account of the size of the growth and the mass in the right parametrium, it was decided to treat the patient for an inoperable carcinoma with intracervical application of radium and short wave X-rays. On October 17 the cauliflower growth had reduced about one-half in size but the other condition in the pelvis was the same.

When she returned for a third examination on December 1 it was found that this cauliflower growth had been reduced to one-third of its former size and that it was very fibrous; but otherwise the condition in the pelvis had remained exactly as it was on the first examination. Histological examination of the tissues removed on each of the three previous examinations showed it to be an adenocarcinoma. In view of the fact that the cauliflower growth had not disappeared, it was decided to perform an exploratory operation to see if it were possible to remove the uterus. On opening the abdomen we found a large mass within the right broad ligament which proved to be a lipoma and was removed. An extended panhysterectomy was then performed. The cauliflower growth had a pedicle which was attached to the cervical wall. There was absolutely no invasion of the rest of the uterus.

The case is reported for the following reasons: (1) the large lipoma was within the broad ligament; (2) the adenocarcinoma occurred in a pedunculated growth and the pedicle was attached to the cervical mucosa without any extension into the cervical wall; (3) there was only partial retrogression in the size of the growth after the radiation treatments; (4) primary healing of the exploratory incision was not retarded in spite of the massive doses of roentgen-rays and radium which had been administered on previous occasions.

HETEROTOPIC NIPPLE

DR. EMIL RIES: A white woman, 40 years old, was to be operated on for multiple fibroids. At examination a nipple-like structure was found 2 centimeters above the right anterosuperior spine of the ilium. The nipple was 3 millimeters in diameter and 1 millimeter high. A ring shaped area 3 millimeters in diameter around it and the nipple were a little more pigmented than the surrounding skin. This nipple was removed. The microscopic examination showed epidermis with papillæ and brown pigment in the basal layer. From the middle of the nipple a slightly tortuous duct extended downward into the cutis, but ended blind without any coil formation. The duct had two layers of epithelium, the inner cuboidal, the outer rather flat and somewhat irregular. The lumen was distinct. At the point at which the duct passed through the epidermis there was a straight canal, not a spiral one.

The duct looked very much like the duct of a sweat gland, but as the ducts of the sweat glands are known to pass through the epidermis in a spiral, this duct was deemed to be a milk duct and the structure was diagnosed a rudimentary accessory nipple. The patient stated that after the births of her children this structure did not enlarge nor secrete.

HÆMATOMA OF THE RIGHT OVARY WITH SEVERE HÆMORRHAGE IN THE PERITONEAL CAVITY

DR. DAVID C. STRAUS: The patient, L. M., 19 years of age, single, was first seen by me at 12:30 a.m., January 13, 1925. She complained of pain in the right lower quadrant of the abdomen, very severe, localized, and accompanied by nausea but no vomiting. She did not look very ill and her color was good. Three days before, January 10, she began to have slight pain in the right lower quadrant of the abdomen while at work. The pain increased in severity for three days but she continued her work. The pain remained localized, however, and she felt nauseated but did not vomit. The third night she went to the theater where the pain became so severe that she could hardly keep her seat. She came home and called her family physician, who in turn called me.

When I arrived she was lying quietly in bed but complained of severe pain though she said it was not as severe as it had been a short time before. Her

pulse was 80 and of good quality. Temperature by mouth was 98.6 degrees. Except for a suggestion of more resistance on the right side low down than over the left, there were no abnormal physical findings. She did not remember the exact date of her last menstruation but said it was about a month before. Her breasts were normal, not enlarged.

The history indicated acute appendicitis. The white blood count was 19,500, the differential count showed 76 per cent polymorphonuclears. Rectal examination showed no striking findings. There was some tenderness high up on both sides, perhaps a trifle more on the right than on the left—no bulging was made out. There was no vaginal discharge and no Chadwick sign.

When the patient arrived at the hospital, a rectus rigidity was more pronounced, and the temperature per rectum was 100 and pulse 80. The local findings seemed clearly to exclude the possibility of a ruptured ectopic pregnancy or acute salpingitis. It is to call attention again to ruptured ovarian cyst in the differential diagnosis of acute appendicitis in women that I am reporting this case.

Immediate operation was arranged for. The abdomen was opened by means of a low McBurney muscle-splitting incision. On opening the peritoneum a gush of bright red blood poured from the wound. The interne thought I had cut a large artery, but as I had seen the same picture in a case some years ago I at once stated that it was an ovarian hæmorrhage with rupture into the peritoneal cavity. I at once enlarged the incision by continuing the skin incision in its original direction and by dividing the deeper layers parallel to and along the outer border of the rectus. This gives a very satisfactory exposure of the right adnexa. The right ovary was quickly found. It presented a swelling about the size of a plum. On grasping it gently a large blood clot came from within it and the mass collapsed. The very large amount of free bright red blood in the right iliac fossa and pelvis was sponged away and flowed out through the wound, a total of probably one quart in all. There was a large bleeding surface which extended for practically the entire length of the ovary which was elongated and shaped more like a finger than an ovary. The distal half of the ovary was discolored from interstitial hæmorrhage and several small follicles were seen filled with blood. The bleeding came from a large ruptured follicle located at the surface and occupying the entire distal one-half or more of the ovary. This portion of the ovary was resected. Next the left hand was introduced into the Douglas and numerous massive blood clots were lifted out. The uterus was palpated and was normal. The right tube was normal as were also the left tube and ovary. The appendix was not seen. The remaining liquid blood was carefully sponged away with gauze sponges, all bleeding controlled, and the abdomen closed in layers without drainage. The patient left the table in good condition. On return to bed her pulse was 80 and of good quality. She made an uneventful recovery and was discharged on January 22, 1925. She began to menstruate two days after the operation.

The pathological report showed the specimens to be follicular cysts of the ovary. No endometrial tissue was present in the ovary. Up to June, 1924, only 59 cases had been reported in the literature. At this time Phaneuf reported 2 additional cases and gave an excellent review of the subject. Of the 59 reported cases with intraperitoneal hæmorrhage, the bleeding was from follicular cysts in 20, from corpus luteum cysts in 22, and from hæmatic cysts (type not stated) in 17. He pointed out that the preoperative diagnosis made in most cases abstracted from the literature was ectopic pregnancy or acute appendicitis. In most instances the true diagnosis was not established until after the peritoneal cavity had been opened. Obviously, although the condition is infrequent, it should be considered in the differential diagnosis of acute abdominal conditions.

OVARIAN FOLLICULAR CYST SIMULATING ECTOPIC PREGNANCY

DR. CAREY CULBERTSON: Mrs. L. F., aged 32, was of a slender, undernourished type. She had 2 children, 4 and 2 years of age respectively. Menstruation began at 15, was of the regular, 28 day type, 4 days in duration. The last period was August 12, 1923, occurring at the regular time. On August 26 she began bleeding again but this was intermittent and scanty and not like a regular period. For 4 months she had had severe lumbar backache, which was worse in the morning and on arising from a sitting posture. For the past few days there had been some tenderness and soreness in the lower abdomen on both sides.

Examination on August 31 showed the abdomen scaphoid, thin-walled, with superficial tenderness over both lower quadrants; but no masses were palpable. On vaginal examination the cervix was soft and pointed toward the back. The corpus of the uterus was upright, slightly enlarged, and free. There was a lemon-size mass which was tender on the right side between the uterus and the pelvic wall. The left side was normal. She fainted after the examination and was taken directly to hospital.

She was operated on the following morning. The uterus was upright but relaxed, small, and firm. The left tube and ovary were normal except for 3 small cysts on the fimbriæ of the tube. The right tube was patent. Stretched about the circumference of the right ovary was a cyst 6 centimeters in diameter with evidence of recent hæmorrhage. It was reddish-blue in color. The appendix and gall bladder were free and normal. There was some ptosis of the colon. A right salpingo-oophorectomy was performed, with shortening of the round ligaments for peritonization.

I report this case because of the very slight extent of the pathological lesions found and because of the close resemblance to the findings in ectopic pregnancy in spite of the fact that there was no preceding amenorrhœa. The cystic portion of the ovary proved

to be a recent hæmorrhage into a follicle. It was not a corpus luteum cyst. Microscopic sections showed no tissue endometrial in type and no evidences of pregnancy.

GUNSHOT WOUND THROUGH THE PELVIS CHARACTERIZED BY AN UNUSUAL ANATOMICAL COURSE

Dr. Carl Alfons Bacon: I wish to report briefly a case of gunshot wound through the pelvis which is characterized by a rather unusual anatomical course, and invite your discussion on its management.

The patient, a woman of 25, was shot at close range, with a special soft-nosed bullet of 0.32 calibre. The shot entered just above and about 2 centimeters to the left of the symphysis pubis. It followed between the symphysis and the bladder and severed the urethra in about its middle portion, tearing it out completely in that region as it entered the vagina. It left the vagina on the right side about 1 centimeter inside the vulva, missed the rectum, and emerged inside the middle of the right glutæus maximus muscle, without damage to any nerves or arteries of importance. Another shot which entered the head in front of the left ear, and curved down to the back of the neck, caused a large amount of hæmorrhage, so that she was in a state of considerable shock when first seen. Twenty-four hours after the injury, without at that time knowing the exact extent of the injury, as the patient had not passed any urine, we attempted to catheterize in the ordinary manner, without success. The second day, 40 hours after the accident, we prepared the patient exactly as for a vaginal operation for the purpose of passing a catheter into the bladder, through the posterior portion of the urethra, from the site of the injury under a good view, if possible. On account of the trauma, we were again unable to do this; in fact we were unable to determine the condition of the posterior urethra because of œdema of the labia and a large hæmatoma in the right vulva.

Finally we made a direct opening into the bladder from the vagina, forming a fistula into which we inserted a retention or Pezzer catheter. A large amount of urine was found in the bladder.

We partly justify the intentional formation of a fistula by the need for drainage later when a plastic repair of the urethra is to be done. With a finger in this fistula we were not able readily to palpate the urethral orifice, with a view to passing a catheter through it from within.

I would like to know whether we should have waited longer for a possible spontaneous emptying of the bladder. Would it have been preferable to make a suprapubic cystostomy? How can we best restore the urethra?

DISCUSSION

Dr. N. S. Heaney: Why was the Pezzer catheter put in? Those fistulæ will stay open without the insertion of a catheter, which only adds to the discomfort of the patient. When we make an artificial fistula to clear up a tuberculous bladder or an intractable cystitis we usually make an incision and sew it back and forth and leave it open. The fact that the bladder had to be drained showed that the urethra was still functioning. If plenty of time were allowed the urethra might heal and the lower end could be found when the œdema had disappeared.

Dr. Henry Schmitz: Was there much tissue missing? In 1 case I was obliged to make a repair on account of involuntary urinations. The inflammatory reaction had subsided so that I could find the posterior portion of the urethra. I put in an ordinary catheter and then brought the upper portion of the urethra down to the distal part. I used only one stitch. It is a well-known fact that the urethra tends to heal very rapidly. Rapid healing followed in this case and the catheter was removed after 7 days.

Dr. Bacon (closing the discussion): I think the whole middle portion of the urethra was missing. I tried to follow the urethra with a small probe, but the mucosa was retracted and there was considerable swelling. I made the fistula about a centimeter back from the traumatized area. I wonder if it would not be best to try to see the internal orifice with a cystoscope in the fistula.

ECTOPIC CARCINOMA OF BREAST

Dr. Emil Ries: Case 1. A woman, 31 years old in 1921, had had 2 children, the last in 1918. She had had a breast infection after the first labor which caused her to wean the child at the age of 4½ months. After the second labor she nursed 10 months without difficulty. She had enlarged glands in the left axilla which were discrete and painless. Outside the left breast along the border of the pectoralis major, a little above the breast proper there was a firm roundish tumor the size of a 50-cent piece, not adherent to the skin and freely movable. It was thought to be a fibroma of an accessory breast and was removed under local anæsthesia. The microscopic examination showed the tumor to be a scirrhus. Radical operation was done and a year afterward the patient was found free from recurrence.

Case 2. A woman, 33 years old, observed in 1922, had been operated upon by a Chicago surgeon in 1917. At that time she was curetted. A week later she had hysterectomy for fibroids and appendectomy and a radical operation for right inguinal hernia. In 1919 on some exertion the hernia recurred. She had never been pregnant. She complained of a tumor below the left breast and pain in the abdomen. Examination showed a recurrent right inguinal hernia, firm median abdominal scar, a left ovarian tumor the size of a grapefruit and a small uterine stump. Below the left breast and apparently without connection with the breast, a tumor was felt which was firm and sensitive to touch. It rolled under the finger and was cylindrical in shape. It was about 8 centimeters long and 3 centimeters in diameter. It

was thought to be a fibroma. At the operation the left ovarian tumor was removed by an incision through the old median scar; the recurrent hernia was operated upon after Andrews' method. Then the breast tumor was excised and examined microscopically. It was found to be a scirrhus. Radical operation was performed at once. The patient made a good recovery and was reported well 3 years after the operation.

In both of these cases the tumor originated ectopically in accessory breast tissue without any connection with the breast proper, and the microscopic examination showed no carcinoma in the breast itself.

DISCUSSION

Dr. C. D. Hauch: Was there any special difficulty in making a repair in the first case reported? Was there any difficulty in getting the skin approximated or was there any sloughing afterward? I have a case now that is convalescing from an operation for such a tumor. I had considerable difficulty in getting the skin approximated in the axilla.

Dr. Ries (closing the discussion): In these 2 cases we had no difficulty in approximating the skin such as we often have in extensive carcinoma. Many times in difficult cases we split the other breast in two and use the flaps to close the wound, putting the nipple in the center of the chest. In other cases we leave a large wound open to prevent too much tension and use skin-grafting.

A CYST OF THE ISCHIORECTAL CAVITY

Dr. Emil Ries: The patient with this cyst was 33 years old when she came under treatment in 1923. She had had four labors. The first took place in 1909 spontaneously. Ten days after it the physician found a tumor in the vagina, but on the following day the tumor had disappeared and the patient went home. In 1913, in the fifth month of her second pregnancy, a second physician discovered a cyst in the vagina. The cyst was drained and partially removed. The wound healed in 4 weeks and the patient was confined at term without any difficulty. In 1917 and in 1919 the patient was confined at term without abnormalities. In April, 1923, the patient had a feeling of pressure in the rectum. A third physician who examined her found only retroversion and small cysts of the cervix. Soon afterward the patient had pain in both thighs and severe fever. The physician found an abscess forming to the left of the rectum which was opened and curetted in May, 1923. In October, 1923, this treatment was repeated, but the abscess never closed and continued to discharge pus.

November 27, 1923, the patient was found to have a small opening to the left of the anus into which a probe could be introduced to fully 15 centimeters. The probe moved around in a large cavity which communicated neither with the vagina nor the rectum. The uterus was retroverted, freely movable, and the adnexa were free.

The patient was operated upon November 28, 1923. An incision was made around the fistulous opening and carried across to the outside almost to the tuber ischii. The fistulous duct which started at the opening near the anus was dissected out as in the extirpation of a fistula *in ano*. Higher up a large cavity lined with a mucosa and containing pus was exposed and dissected out. On the outside of the sac there were numerous (about 20) small cysts filled with clear fluid, thin walled, of the size of a lima bean and smaller. These were removed with the large sac. The dissection had led deep into the ischiorectal space, but had nowhere opened into the rectum or vagina. Sutures and ligatures stopped the hæmorrage, which was not serious at any time. Deep sutures through the skin and fat closed the wound almost entirely. A small gauze pack was left in the wound. The patient made a good recovery and has had no return of her trouble.

The specimen showed in its upper part a round sac without any defect of continuity. The lower part appeared much like any fistulous tract and was lined with granulation tissue in a fibrous wall. The sac was large enough to contain a woman's fist. Its inside was lined with a stratified epithelium which covered a loose connective tissue which formed no papillæ. The epithelium was like that of the vagina; it contained no stratum granulosum and no stratum lucidum. The cells of the most superficial layers contained well stained nuclei and the uppermost layers of cells were slightly loosened and evidently becoming detached.

The transparent cysts of the outside of this vagina-like sac had an entirely different microscopic appearance. Their epithelium was of two types, one type, investing the greater part of the circumference of the cysts, was a single layer of columnar or cuboidal cells, here and there with ciliæ. A second type was found on connective tissue papillæ protruding into the lumen of the cysts and consisted partly of single layers of high cylindrical cells and partly of multiple layers of cylindrical cells which here and there, according to the direction of the sectioning, appeared in many (4 to 8) layers. The sac was imbedded in loose connective tissue without a muscular coat.

It is difficult to explain the origin of this tumor unless we go back to embryonal displacement. While the main part of the sac resembled very much vaginal structures, the transparent cysts attached to the outside were evidently of an entirely different nature. Since the entire structure was found outside the levator ani it is difficult to assume any connection with the ureter or any part of the wolffian duct.

I have been unable to find any similar observation in the literature.

A NORMAL OBSTETRICAL CASE IN WHICH THE INFANT'S BLOOD SHOWED A DISTINCT TYPING

Dr. Sidney Schochet: I wish to report a normal obstetrical case, para-ii, who gave birth to a normal

female child. Two hours after delivery there was a severe hæmorrhage from the cord and mucous membranes. We tried the usual methods of controlling this hæmorrhage of the new-born and we finally decided upon the question of blood transfusion. The mother was typed and found to be Type III. The father was Type IV. We had taken some blood from the child just as a matter of routine and found it was Type II. As you all know, as a rule, there is no definite type in children until the end of the first year or during the first year. I report this case because of the fact that it is one of the theories of the cause of eclampsia that when a child *in utero* shows a definite typing the mother presents symptoms of eclampsia. In this case there was a definite typing but no symptoms of eclampsia.

OCCLUSION OF THE VAGINA—ONE CASE WITH EPIDERMAL CYST

Dr. Emil Ries: Case 1. A married white woman came in 1925 with the following history: In 1902 at the age of 9 months she had what was called black diphtheria in the throat and was very sick with it. She does not know whether the vagina was affected at the same time. She also had had measles and whooping cough during infancy.

In 1914 at the age of 13 she had for a period of 6 months, at about monthly intervals, intense pain in the abdomen, deep in the pelvis and in the back accompanied by nausea and vomiting. The pain and vomiting became more intense as time went on, lasting from 5 to 14 days. She was taken to a hospital for operation, but on the morning of the day set for the operation she passed a large quantity of black tarry blood. No operation was performed. The flow at that time lasted 2 weeks and returned afterward regularly at 28-day intervals, lasting 3 to 5 days and was of moderate amount accompanied by slight pain.

In 1925 she married. Soon afterward she noticed a constant grayish vaginal discharge. It was found on examination that the external organs were normal. The hymen was broken. The vagina for 3 centimeters above the hymen was normal, but an obstruction was met which closed the vagina apparently completely. A small dimple was felt a little to the left of the mid-line which on speculum examination showed a grayish discharge from higher up.

The obstruction was cut transversely and the vagina was found perfectly normal above with a well formed cervix. Uterus and appendages were normal. After excising the obstruction the upper and lower edges of the vagina were sutured together. The patient made a good recovery and on examination some 3 months later showed a well healed vagina with a slight cicatricial ring at the site of the former obstruction.

Case 2. A colored woman, 21 years old, came to the Dispensary in 1924. She had had malaria and measles. At the age of 15 she began to menstruate and the menstruation returned regularly, lasted 3 days rather copiously with a little pain. At the age of 19 she had her first labor at term. A physician attempted some interference through the vagina, but could not finish the delivery. The patient was then taken to a hospital where labor terminated spontaneously. After the labor some sutures had to be made. There was a bloody discharge for 3 days, then a yellow discharge for 1 month, for which she used vaginal injections. She knows nothing of any septic condition. Since that time she had had no menstruation, but pain in the abdomen and back every month. Cohabitation was painful and she stated that the membrum did not enter as far as before the confinement.

December 8, 1924. Complete occlusion of the vagina was found about 3 centimeters above the introitus. Per rectum the uterus was found large, the right appendages thick, and the uterus was freely movable. The following day she entered the hospital and noticed for the first time then that she was flowing. The blood was very dark and she stated that after the dispensary examination she had had severe abdominal pain.

December 10, 1924, it was found that the occluding membrane was located about 3 centimeters above the introitus, which was normal with the exception of a small perineal tear. The occluding membrane presented cicatricial white stripes. A little to the left of the median line there was a small opening from which blood was escaping. A uterine sound could be introduced through this opening. It was enlarged by means of an artery forceps so that a finger could enter the upper part of the vagina. A normal cervix could be felt and a hard uterine body above it.

December 11, 1924, at operation an olive sized tumor could be felt in the occluding membrane to the right of the small gap. The membrane was excised and the olive shaped tumor was enucleated with slight hæmorrhage. Above the obstruction more cicatrices were found in the vagina which bound the cervix to the vaginal wall. Suture of the upper and lower parts of the vagina formed a vagina which easily admitted 2 fingers. Recovery was uneventful.

The tumor included in the obstructing membrane was a cyst the size and shape of an olive. It contained a small amount of yellowish thick fluid. Sections through the wall showed on the outside connective tissue, and no muscular coat. The lining of the cyst consisted of stratified epithelium similar to vaginal epithelium, but without any papillæ. The intercellular bridges between the rete cells were very distinct. There was no stratum granulosum and no stratum lucidum. The superficial layers were slightly flattened, but contained well stained nuclei. No glands or inflammatory changes were present.

The history of both cases is quite characteristic of an acquired occlusion of the vagina. In the first case the early severe diphtheria attack, though not positively known to have involved the vagina, is most likely to have caused ulceration and subsequent cicatricial fusion of the walls of the vagina.

In the second case special interest attaches to the cyst. The fact that it presented no muscular struc-

tures in its wall and had no papillæ speaks against its being a rudimentary double vagina. It must be classified with those numerous cysts of similar structure which are observed near the introitus after obstetrical lacerations and are dependent upon the growth of small islands of vaginal epithelium detached by the obstetrical injuries and displaced into the connective tissue outside the vagina. I have examined a number of these cysts and the structure is quite uniformly that described, though the size is usually smaller.

DISCUSSION

DR. N. S. HEANEY: There was a point in each of the cases on which I was not clear. In one case he said the vagina was about 3 centimeters above the hymen. Was the epithelium from there up to the cervix obliterated? Was there a considerable passage up there? Was the occlusion a transverse membrane above the hymen?

I have had one case of obliteration of the vagina which came on after the woman was married and followed an attack of influenza in which she was seriously ill. The attending physician said she passed a membranous coat of the vagina. This healed in and occluded the upper two-thirds of the vagina. All the epithelium in the upper two-thirds of the vagina was destroyed except that covering the cervix. The upper two-thirds of the vagina was dilated, and the cervix was pulled down and stitched to the lower third of the vagina. Her doctor reports that the vagina appears to be quite normal.

DR. RIES (closing the discussion): It all depends on how much ulceration has taken place. If there is extensive ulceration, extensive occlusion may follow. In both of these cases the history seems very clear as to the origin of the obstruction.

THAT PAIN IN THE VAGINA

DR. EMIL RIES presented a paper on "That Pain in the Vagina," which will appear with the discussion in a later issue.

PHILANDER ABBEY HARRIS
ERNEST BUMM
FRIEDRICH TRENDELENBURG

CHARLES S. BACON: I have been asked by our President to say a word about the prominent gynecologists who have died recently.

Let me first recall to your memory Philander Abbey Harris of Paterson, New Jersey, who formerly attended quite regularly the Section on Diseases of Women of the American Medical Association. He obtained his medical education at the University of Michigan and Columbia University. He was also a Fellow of the American Gynecological Society. At the Society meetings he participated in the discussions as an earnest, thoughtful student and made the impression of a physician in whom all could repose confidence. A valuable contribution was his method of digital dilatation of the cervix. He died, December 13, 1924, at the age of 72 years, after a long illness.

The gynecologists of America, as well as those of Germany and indeed of all the world, will unite in mourning the death of Ernst Bumm, who died in Munich on January 3, after an illness of 3 days, from peritonitis following rupture of the gall bladder. He was generally acknowledged as the greatest German gynecologist and at the time of his death, although 67 years old, he was at the height of his power.

Bumm was born at Wurzburg in 1858. After his graduation in medicine he was for 3 years assistant of Scanzoni and became Docent at the early age of 27 years. In 1894 he became professor in Basel and in 1900 he came to Halle as the successor of Fehling. In 1904 he came to Berlin in the Frauen Klinik of the Charité as the successor of Gusserow and in 1910 on the retirement of Olshausen he succeeded him in the Universitats-Frauenklinik.

I saw him but once, in the Charité, but his personality made an impression not to be forgotten. He was a wonderful lecturer and his skill in drawing added greatly to his power. I saw him do a radical carcinoma operation. He was a rapid and skillful operator but did not excel in precision.

Bumm was probably best known in America by his textbook on obstetrics, one of the best textbooks ever written and illustrated as no book had been before its appearance. At the time of his death he was preparing another book that would have rivaled his obstetrics—on gynecological operations. One part of this great work is said to be in the hands of the printers and will be looked for with much interest.

Bumm's first work was in the study of gonorrhœa and he was the first or one of the first to culture the gonococcus. His interest in bacteriology continued to the last and he made many contributions to the subject of puerperal fever, mastitis, and other infections.

Among the other subjects to which Bumm gave especial attention, we should mention carcinoma of the uterus. After a large experience in the radical abdominal operation he made a thorough trial of radium and roentgen therapy, which, however, he finally abandoned.

As a teacher, as a writer, as a research worker, as a man interested in the social problems of mankind and as a great and impressive personality, we can honor Bumm, who has well represented our specialty and added luster to our profession.

We cannot omit a word of appreciation of the great surgeon, Friedrich Trendelenburg, who died in Berlin, December 16, at the age of 80 years. He was professor of surgery in Rostock and Bonn and went to Leipzig in 1895. Among the numerous contributions to surgical problems we are especially interested in his discovery of the value of the elevated pelvis in abdominal operations. The importance of this method in pelvic surgery can scarcely be overestimated. We are glad to add our tribute to the memory of this great man who lived to enjoy the prominence and honor due a useful life.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

A DISCOURSE OF THE WHOLE ART OF SURGERY BY PETER LOWE, SCOTTISHMAN

THIS work by Peter Lowe is one of the most delightful surgeries ever written. The man is so genuine and soul bound in what he has to tell that his personality dominates his every word and the reader feels as if he were listening to the author and is hearing a pleasant and interesting speaker rather than reading a book. Though Lowe had but little to offer that was new or original, he had had every opportunity of studying the methods of the time and knew how to classify his knowledge and what was still more valuable, possessed the ability to put it out in clear and pleasant style. Born in Scotland, probably in Errol, in 1550, he left there at an early age and received his education in Paris. The value of this early training and the soundness of the French method evidently greatly impressed him for many years later he used it to great advantage. After receiving his education he practiced in France and Flanders for twenty-two years. He then passed through the war period of his education where he came in contact with the methods of Franco and Paré and absorbed the good of each. In 1589 and 1590 he was Surgeon Major to the Spanish Regiments at Paris and then as he says "next following the French King (Henry IV) my master in the warrs 6 years, where I took commodities to practice all points and operations of Chyrurgery. Upon which occasion I endeavoured my self to collect my practises at vacant hours, into this Book, according to the opinion of the ancient and learned practitioners, in Physick and Chyrurgerie, in such plain terms as I could, for the use of the common sort: which now I doe offer to thee newly corrected and enlarged for thy greater comfort."

The work under the title "A Discourse of the Whole Art of Surgery" etc. was first published in 1596, when he had returned to London where he remained until 1598, a new edition appearing in 1597. He republished the book in 1612 writing a new dedication, epistle to the reader, and letter to Gilbert Primrose and James Harvie. After the author's death the work was reprinted twice, the final edition appearing in 1654. The work thus had a life of 58 years.

While in France, Lowe was appointed doctor in the faculty of surgery at Paris and ordinary surgeon to the French King and Navarre. In 1598 he returned to Glasgow and there took up the cudgels for medical education and licensure. Clowes and Bannister had preceded him by a few years and the question of putting down the quacks and itinerant surgeons was a very live one in the British Isles. In his letter of 1612 to Primrose and Harvie, Lowe takes this up and only space prevents me from quoting his remarks in full. They are so well worth while. He divides the quacks into eight or nine different classifications and then goes on to describe the various types. The upshot of the matter was that in 1599 "The matter being considered, and the abuse weighed by his majestie and Honourable Councell, thought not to be tolerated, for the which I got a priviledge under his Highnesse privie seal, to try and examine all men upon the Art of Chyrurgerie, to discharge, and allow in the West parts of Scotland, who were worthy, or unworthy to professe the same." He also received from King James IV the royal privilege to found a school of medicine based on the pattern of Parisian medical education and in 1599 as the result of this the Faculty of Physicians and Surgeons of Glasgow came into being. The date of his death is given as late in 1612 or early 1613. His introduction and letter are dated December 20, 1612, which must have been very shortly before his demise.

Lowe's book follows the stereotyped outline of books of the day and in part is written in question and answer form, Peter, the father, acting as interlocutor and John, his son, answering the questions. One of the most interesting things in the book is his clear and concise description of an amputation; one can almost see the operation going on. He makes a distinction between clean and infected amputations in so far as hæmostasis is concerned; in clean he used the ligature, in infected, the actual cautery. He also strongly urges that it is better to cut into uninfected tissue and possibly sacrifice some good tissue than try to cleave too close to the line and run the risk of later spread of infection. He scrapes away the periosteum and performs an aperiosteal amputation.

Appended to the 1654 edition is Lowe's translation of Hippocrates which appears under the title "The Presages of Divine Hippocrates." The presages or prognostications are preceded first by a dedication, dated 1611, then follows Lowe's translation of the Hippocratic oath, fuller and in some ways more interesting than the version in common use today, and finally a short life of Hippocrates. The work was evidently intended for use by the students in the newly founded medical school in Glasgow.

REVIEWS OF NEW BOOKS IN SURGERY

TO the older surgeon, Lewis Stephen Pilcher's charming book[1] recalls an endless number of the most stirring experiences in the evolution of American surgery and its literature. It carries him through the experiences of the early days of antiseptic surgery, reminds him of the remarkable work of the self-made giants of an early day, of their ideals, and of their heroic efforts in accomplishing their realization. It pictures the beautiful character of the author enjoying the arduous labors of having a large share in bringing about the progress that has been made in American surgical literature and education.

The book describes the organization of the American Surgical Society and the founding of the *Annals of Surgery*, and the influence of the Society and the Journal upon American surgery. This Society brought together the surgeons best qualified to speak with authority from all parts of North America. When clarified by critical discussion in the annual sessions, published for nearly half a century in the *Annals of Surgery* under the editorship of Dr. Pilcher the ideas of these surgeons have held the enviable position of serving as a foundation upon which surgeons the world over have been accustomed to lean. The journal, which represents one important feature of the author's life work, has served more than has any other agent to give prestige to American surgery. It has served as a source of inspiration for much important surgical development.

The description of medical education in the author's student days has historical interest, especially when considered with the development shown in the later chapters of the book.

The author's patriotic service in the defense of the Union, and later as an officer in the navy, are interesting. His experiences as a teacher and a hospital surgeon make interesting and inspiring reading, and together with his contributions as editor and scientist give one a fair idea of the tremendous work accomplished by a man thoroughly filled with the enthusiasm of a leader in surgery and willing to carry the burden which the responsibility of this position carried with it. His love for and appreciation of the works of the great men in surgery of former times is shown in the fascinating chapter on "The Old Masters in Medicine." His collection is one of the best in this country.

The remaining chapters are all charming and show many of the remarkable and lovable qualities of the author.

The book will give to the older surgeons hours of pleasant reading filled with reminiscence, and to the younger members of the profession a wealth of inspiration and a wonderful source of encouragement.

A. J. OCHSNER.

[1] A SURGICAL PILGRIM'S PROGRESS, 1845–1925; Reminiscences of Lewis Stephen Pilcher. Philadelphia: J. B. Lippincott Company, 1925.

A NEW and elaborate work of three volumes[2] on malignant tumors, contributed by a large number of prominent European surgeons and clinicians, is edited by Zweifel and Payr of Leipzig. The first volume has been published. The work is written by clinicians specially for clinicians, placing the clinical problems of tumors in the foreground but giving a very complete and masterly discussion of the present status of our knowledge of the pathogenesis, diagnosis, morphology, manner of spread, symptomatology, clinical course, and the modern treatment of neoplasms.

The general pathology of malignant neoplasms is written by Borst, Germany's best known pathologist, specializing in the pathology of tumors. Germany's foremost clinicians have joined in this work to present their extensive experience for the general practitioner and the specialist as well. Debanco and Unna discuss the malignant tumors of the skin; Kuettner, of the skull; Pette and Payr, of the brain and cord; Sattler, of the eye; Knick, of the ear, nasal passages, pharynx, and larynx; Partsch, of the tongue, mouth, and jaw; Hernecke, of the parotids; Kocker, of the thyroid, parathyroids, carotid gland, and branchogenic tumors.

All the contributions are well and richly illustrated and supplied with complete bibliographies of the essential literature. The main purposes of the work are to foster a more general knowledge of malignant neoplasms among medical practitioners without too elaborate pathological and antomical considerations; to encourage early diagnosis and treatment by the knife, X-ray, and radium, and chemotherapy; and to fight the dogma of the incurability of cancer. Early diagnosis and treatment are the leading features of the work and the dominant objects of its editors.

F. R. ZEIT.

SINCE the effectiveness of heat in the treatment of both cancer and gonorrhœal infections and the value of diathermy for the production of thermal effects at various depths in the tissue have been demonstrated, we welcome the monograph of Corbus and O'Connor.[3]

In gonorrhœal complications of the cervix and epididymis, the authors have developed a distinct advance in treatment. Gonorrhœa in women has been a discouraging condition for treatment because of the presence of the gonococcus in the cervical and endocervical glands. That gonococci are instantly destroyed by a temperature of 113 degrees F. has been shown frequently. Applications to the cervical canal of heat at 117 degrees F. can be easily applied by modern instruments without discomfort.

[2] DIE KLINIK DER BOESARTIGEN GESCHWUELSTE IN DREI BAENDEN. Edited by P. Zweifel und E. Payr. Vol i. Leipzig: S. Hirzel, 1924.

[3] DIATHERMY IN THE TREATMENT OF GENITO-URINARY DISEASES WITH ESPECIAL REFERENCE TO CANCER. By Budd C. Corbus, M.D., F.A.C.S., and Vincent J. O'Connor, S.B., M.D. Minneapolis: The Bruce Publishing Company, 1925.

Diathermy with the use of the Corbus thermophore in early epididymitis relieves pain and shortens materially the length of disability.

We hoped that radium and X-ray would offer us a non-mutilating agent to attack cancer without the shock of operation, but they have not proved so satisfactory as we anticipated. If they are no more than caustic agents, actual cautery would act more quickly.

Diathermy because of its slow cooking or dehydration of the tissue is perhaps the most valuable agent that we have against cancer. The results of treatment of bladder carcinoma are very satisfactory. In a series of 28 cases treated by diathermy in the past 5 years, 12 are free from recurrence after 2½ years and 7 after 4 years. Cancer of the prostate is treated by exposing the gland through a perineal incision and placing the electrode in immediate contact with the fascia of Denonvillier or by inserting the needle electrode into the depths of the carcinomatous area. Cancer of the prostate is the most difficult problem that confronts the urologist. The results obtained by this ingenious method will be observed with interest.

The authors emphasize that, although the book is essentially for the urologist, the general surgeon will find that the principles of technique can be applied to cancer elsewhere in the body.

The text is clear and concise and sufficient clinical data are cited to elucidate their point of view. The book is well illustrated so that the urologist or general surgeon will find little difficulty in applying the technique advised. JAMES A. GARDNER.

THE first edition of the work of Czerny and Keller[1] published almost 20 years ago has been recognized by students of pediatrics everywhere as an outstanding contribution to the nutritional problems of infancy and childhood. In the foreword to the second edition the authors state with justifiable pride that their earlier writings have stood the test of time and that in bringing out a new edition they have found their task to be that of making such alterations and additions as recent researches have made necessary.

How well their work is being accomplished is shown in the first volume of the second edition. It deals with the nutrition of the normal infant and child, including chapters on chemistry, anatomy, physiology, and metabolism. Numerous charts and tables reinforce the text. References to the literature on almost every page show how critical has been their study of the investigations of other workers.

To attempt in a brief review any comment upon the subject matter would be futile. It is enough to say that all those who have followed the pioneer work of Czerny and Keller will be glad to find the later studies of these masters embodied in a new volume. STANLEY GIBSON.

[1] DES KINDES ERNAEHRUNG, ERNAEHRUNGSSTOERUNGEN UND ERNAEHRUNGSTHERAPIE. By A. D. Czerny and A. Keller. 2d. ed. vol. i. Leipzig: Franz Deuticke, 1923.

THE many changes in and additions to our knowledge of that relatively young science which has to do with those micro-organisms causing disease requires frequent revisions of any book covering that science. The eighth edition of Park and Williams' *Pathogenic Micro-organisms*,[2] which includes bacteria, molds, yeasts and protozoa, successfully meets such a necessity. To this end many parts of this book have been rewritten and numerous additions made. The grouping of different bacteria has been changed to meet the classification proposed by the Society of American Bacteriologists and the terminology, advocated by this society, used together with the older and more common names. Well worthy of note is the incorporation of a table giving the essential characteristics, reactions, and pathogenesis of most of the pathogenic micro-organisms, which should be of considerable assistance to students, if used with intelligence. The section on immunity has been revised and, as is to be expected, one finds here an authoritative presentation of the present status of diphtheria prevention and specific treatment. The extensive investigations, stimulated by the World War, on bacteria of war wounds and gaseous gangrene, has called for many additions to the chapter on pathogenic anaerobes. A. A. DAY.

AVERY able treatment of the subject of X-ray therapy in surgical conditions is presented in Juengling's book which contains the latest X-ray methods used in German roentgenological clinics.[3] The author describes the methods which have proved of particular value and gives a detailed analysis of X-ray dosimetry as applied to superficial and deep seated lesions. The biological results of the radiation of the human cell is very extensively presented and there is much concerning experimental investigation on cellular reaction to this medium. The author takes up the various organs in special discussions on reactions to various types and formulæ of X-radiation. He warns against X-ray damage in certain instances and particularly stresses the dangers of radiating malignancy of the larynx and the immediate neighborhood, this being one of the instances in which a pre-operative radiation should not be done, which is contrary to the advice found in some quarters. The anatomical cross section diagram method of dose administration is a feature of this work. In the clinical applications of the roentgen-ray, the author presents much instructive material concerning the benefits of this medium and details are given of successful results in a number of surgical conditions not considered possible in many American clinics. The work covers the field very thoroughly. EDW. S. BLAINE.

[2] PATHOGENIC MICRO-ORGANISMS; A Practical Manual for Students, Physicians, and Health Officers. By William Hallock Park, M.D., Anna Wessels Williams, M.D., and Charles Krumwiede, M.D. 8th ed. Philadelphia: Lea and Febiger, 1924.

[3] ROENTGENBEHANDLUNG CHIRURGISCHER KRANKHEITEN Zugleich Einfuehrung in die physikalischen und biologischen Grundlagen der Roentgentherapie. By Professor Dr. Otto Juengling. Leipzig: S. Hirzel, 1924.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

PRÉCIS DE GYNÉCOLOGIE. By André Boursier. 3d ed. vols. i and ii. Paris: Octave Doin, 1925.

TRATADO DE OBSTETRICIA. By Dr. D. Sebastián Recasens Girol. 5th ed. Barcelona: Salvat, 1925.

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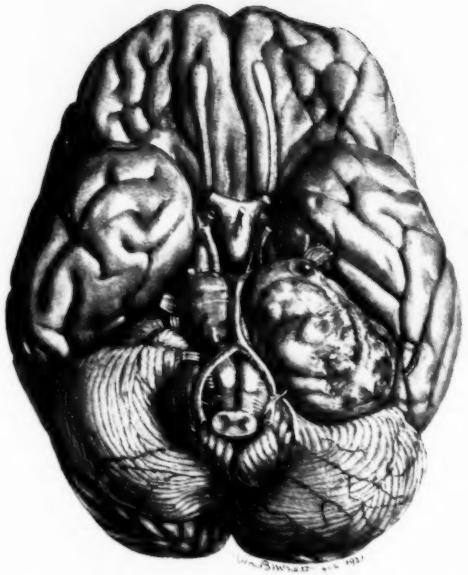

Fig. 1. An example of the characteristic cerebellopontile tumor showing the extent to which the brain-stem is excavated by the neoplasm. The intimate relationship with the medulla and pons explains the great danger which has attended all efforts at removal.

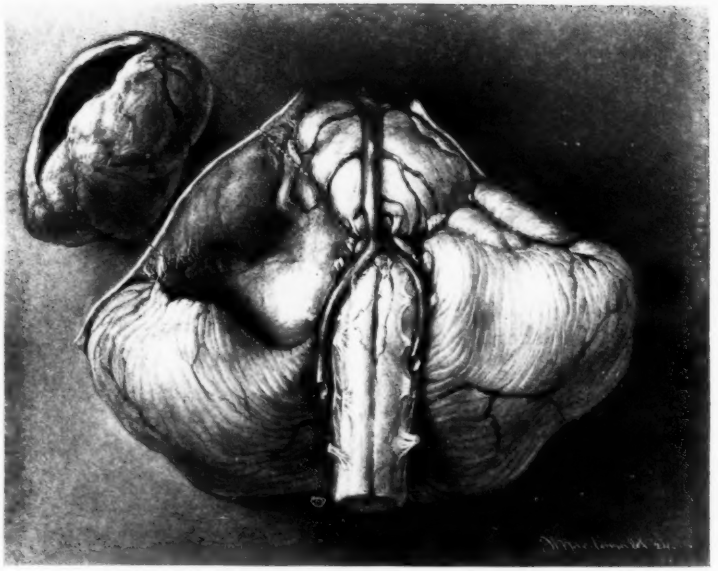

Fig. 2. Necropsy specimen showing the bed of the tumor after the capsule had been carefully removed. At operation the interior of the tumor had been removed and the patient died subsequently of meningitis. The marked excavation and destruction of the side of the pons and mid-brain is shown; also the fifth nerve intact.

An Operation for the Total Removal of Cerebellopontile (Acoustic) Tumors.—*Walter E. Dandy.*